# EDITORIAL

THE average person might be excused for assuming that, with the tremendous technical resources now available to government, educational and commercial bodies, there is no place left in the pattern of progress for the technical hobbyist, working with knowledge and equipment assembled on a purely voluntary basis.

In fact, such is not the case. Here in Australia, for example, amateur astronomers have been able to collect a tremendous amount of tracking data on man-made satellites, which is forwarded regularly to the interested authorities, local and overseas.

This visual data, supplementing that from official "radio telescopes," has assisted greatly in plotting the complex orbits of the satellites, as they gradually lose orbital velocity.

In return for this voluntary service, often more comprehensive than that available from official bodies themselves, amateur groups are advised of new launchings, probable orbits, etc., and treated generally as important contributors to this new era in research.

Not to be left out of it, amateur radio operators chalked up an important "first," earlier this year, when two of them managed to bounce radio signals off American and Russian satellites over the U.S. Atlantic coast. Amateurs elsewhere, including Australia, have done their share of tracking for the I.G.Y. program.

Now groups of radio amateurs are planning to set up teams in Melbourne, Sydney, New Zealand and California to investigate propagation of U.H.F. radio signals via the U.S. Balloon Satellite, Echo I.

They are talking in terms of an aerial with 625 square feet of area and an effective radiated power of 300,000 watts.

It is quite certain that any observations which such groups can make will be analysed with great interest by official bodies. And it is equally certain that such activities will count heavily in favour of amateurs when, once again, their rights are contested to "a place in the ether."

Full marks to the Wireless Institute of Australia and to others who are sponsoring this latest move to co-ordinate the time and talents of local amateurs.

W. N. Williams

# INDEX


| | Page |
|---|---|
| How Will Man React in Space | 3 |
| Telescopes Aloft Probe Space | 4 |
| VLF to Boost WWV Accuracy | 9 |
| Colloids are Important Mixtures | 13 |
| About This Decimal Business | 17 |
| Review—Machine That Teaches and Examines | 21 |
| Review—Light Amplifier is Ultimate | 23 |
| Review—Electric Power from the Sun | 25 |
| Scientific & Industrial News | 27 |
| 144 Mc Transmitter—Part 2 | 31 |
| Serviceman Who Tells | 43 |
| Transporta 7 With RF Stage | 48 |
| Here's Your Answer Tom | 54 |
| Solar Water Heater—Part 2 | 60 |
| Reader Built It | 70 |
| Transistors — Why They Amplify—Part 2 | 76 |
| Let's Buy an Argument | 84 |
| Trade Reviews & Releases | 90 |
| Book Review | 95 |
| Distortion in Audio Amplifiers | 98 |
| Calibrating Your Oscillator | 105 |
| Course in Television | 108 |
| Off the Record—News & Reviews | 117 |
| In Review—By Julian Russell | 126 |
| Amateur Bands | 130 |
| On Shortwave | 135 |
| Answers to Correspondents | 121 |



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## OUR COVER PICTURE

Jets are not the only aircraft with spectacular take-off performance these days. This Piper Super Cub is supposed to be able to take off in the length of a tennis court and is pictured here showing its paces at a recent demonstration in England. It is the smallest of a range, carries two people, and costs around £4000 sterling.

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# HOW WILL MAN REACT IN SPACE?

*This is not a scene from a Buck Rogers film; it's a dress rehearsal for the real thing. No one knows exactly how man will react to space travel, but doctors, scientists and engineers can learn a lot by simulating space conditions on the ground. Here a volunteer at the Boeing Space Medicine division is set up to test the effect of several simultaneous stresses on the human body. He is enclosed in a sealed chamber under conditions of extreme altitude—such that he would die without his pressure suit—in a temperature of 300 degress F., and at a noise level of 125 db above hearing threshold. The effects of these stresses are picked up by a Boeing developed pack of miniaturised medical instruments on the subject's belt. They record heart impulses, brain waves and body temperature.*

# TELESCOPES ALOFT PROBE SPACE

**The latest technique in astronomy — that of sending telescopes aloft in balloons and nose cones — seems likely to provide man with more knowledge about the universe in the spact of a few years, than in all the history of astronomy. Above the turbulence and murk of the earth's atmosphere, even small telescopes out-perform their larger earth-bound counterparts.**

A 36-INCH mirror of quartz may solve the riddle of whether there's life on Mars—and what kind. The big disc will go into a camera-fitted radio-controlled, TV-monitored reflecting telescope being built at Norwalk, Conn. An enormous unmanned Stratoscope balloon will carry it on 20-mile-high flights due to begin in the summer of 1961, to photograph the moon, the planets, and certain "radio stars." A prime objective: to get the most revealing pictures of the Red Planet ever made.

Observatories in balloons, rockets and satellites will make the sixties memorable for astronomers. For the first time, they're viewing the heavens from above the earth's atmosphere. They call it the biggest advance since the invention of the telescope.

From astronomy's beginning, observers have scanned the skies as from the bottom of a murky sea—the turbulent atmosphere. Because of its light-refracting eddies, the stars twinkle; watchers at powerful telescopes get only rare glimpses of faint details like Mars' "canals"; and Mount Palomar's huge 200-inch reflector usually attains only 1/20 of the resolving power, or useful magnification, that it has in theory.

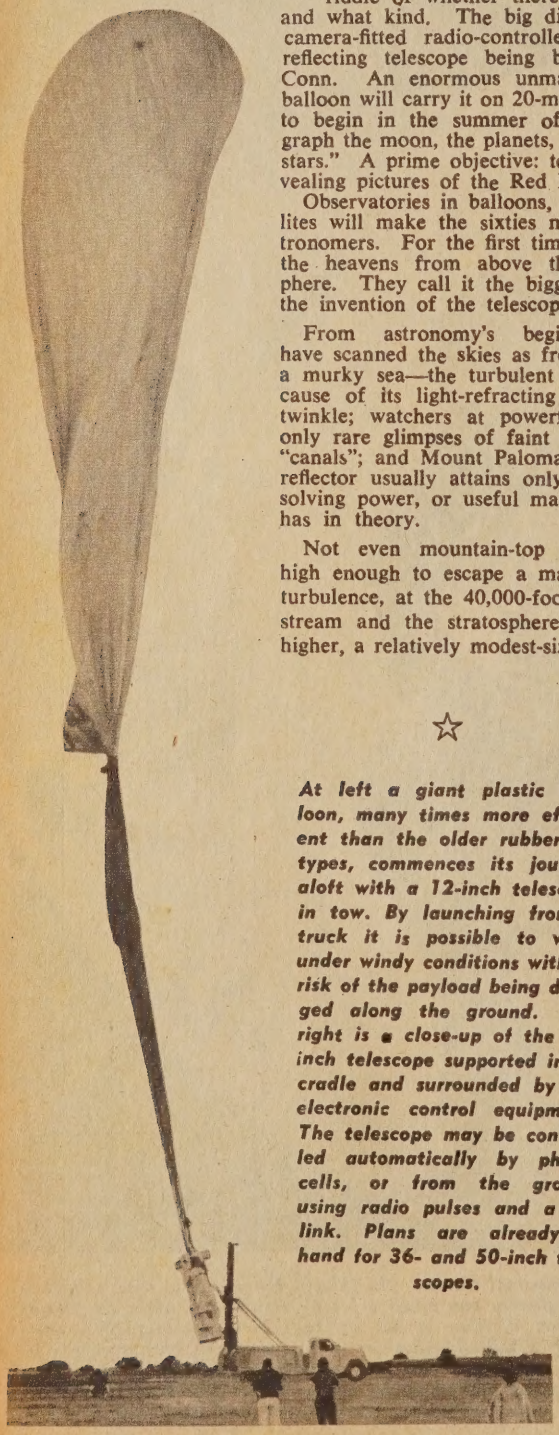
Not even mountain-top observatories are high enough to escape a major region of air turbulence, at the 40,000-foot level, of the jet stream and the stratosphere's floor. Carried higher, a relatively modest-sized spyglass could outdo the biggest earthbound telescopes; and that's the dream now coming true.

Sensational photographs of the sun, the clearest ever made, show what outposts in the stratosphere can do. The pictures are the first fruits of history-making "Project Stratoscope" balloon flights, conducted in 1957 and 1959, and continuing next year. Under the direction of Prof. Martin Schwarzschild, Princeton University astronomer, the unmanned 1,000,000-cubic-foot balloons have been lifting a 12-inch telescope to an altitude of 15 miles—up where the deep-purple sky is almost black, above more than 96 per cent of the world's air.

## THE BALLOON

With a screaming noise heard hundreds of yards away, high-pressure helium gas spurts from the hose of a Navy tank truck to inflate the towering balloon, at an airport outside Minneapolis that serves as the launching site. As the 200-foot-high gas bag lifts and strains at its truck-mounted payload, the truck leaps forward, jockeys into position right under the balloon, and frees the packaged observatory. Within 90 minutes it's stratosphere-high and in business.

Only lately has this "balloon astronomy" become feasible—with the innovation of making balloons of paper-thin plastic, lightweight and strong, instead of the heavier rubberised fabric used before. Transparent and airy-looking,



☆

***At left a giant plastic balloon, many times more efficient than the older rubberised types, commences its journey aloft with a 12-inch telescope in tow. By launching from a truck it is possible to work under windy conditions without risk of the payload being dragged along the ground. At right is a close-up of the 12-inch telescope supported in its cradle and surrounded by the electronic control equipment. The telescope may be controlled automatically by photocells, or from the ground using radio pulses and a TV link. Plans are already in hand for 36- and 50-inch telescopes.***

# NEXT "EYE" FOR OUTER SPACE

*Thirty-six inches in diameter, and made from fused quartz, this disc will be the heart of a new telescope it is planned to send aloft in 1961. A balloon will carry it 20 miles above the earth.*

pearshaped instead of round, the new gas bags come in unprecedented sizes—up to a fantastic 10,000,000 cubic feet, bigger than history's largest airship (7,000,000 cubic feet).

Manned or unmanned, they rise higher, and lift payloads to greater altitudes, than balloons ever did before. Exploiting the high-climbing craft for astronomy, Prof. Schwarzschild has devised novel observatories to hang beneath them.

His camera-fitted 12-inch telescope was entirely self-operating in two initial Stratoscope ascents sponsored in 1957 by the Office of Naval Research (ONR). Responding to photocells, electric motors swung and tilted the 9½-foot telescope barrel to keep it aimed at a preselected part of the sun's face, despite the balloon's motions. A special 35-mm. camera snapped a 1-by 1½-inch, 1/1,000-second exposure every second—8,000 frames in all. Then the observatory, loosed from the expendable balloon, parachuted to earth for recovery of its precious film.

Prize trophy was history's best photo of the sun's oatmeal-like complexion—showing details as small as 180 miles across, and picturing the circulation of incandescent gases in the solar atmosphere. By revealing an unexpected pattern, it revises astronomers' ideas of what goes on in stars. It may also hold clues for harnessing H-power on earth—since the sun offers a look at a successful thermonuclear furnace in action.

## RADIO CONTROL AND TV

In last year's improved system, astronomers on the ground aimed and focused the 15-mile-high telescope by radio command—the first successful remote control of an astronomical observatory high above the earth. Through a TV hookup, observers in a ground-control van watched what the telescope was seeing, and directed it to solar markings of special interest. Four ascents were jointly sponsored by ONR and the National Science Foundation. Magnificent photographs of sunspots resulted.

Next Stratoscope flights will use the new 36-inch telescope. Its builder is the Perkin-Elmer Corp., maker of the earlier 12-incher. Trained on the "canals" of Mars, and the planet's blue-green regions of supposed vegetation, the big reflector should have an excellent chance of solving their mysteries. The exciting project now is triply backed by ONR, NSF (National Science Foundation) and the National Aeronautics and Space Administration.

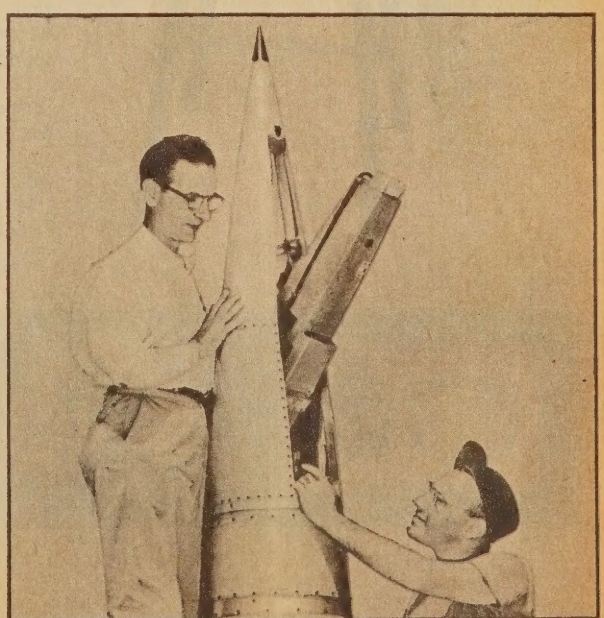
Manned balloons, too, are aiding astronomers. Last November a 2,000,000-cubic-foot ONR balloon lifted two men and a 15-inch telescope for a 15-mile-high look at the planet Venus, and the discovery of water-vapour in its atmosphere, one essential for the existence of life, as we know it. That underscored another advantage of balloon astronomy. Water vapor and oxygen in the earth's air have hindered detecting them on other planets, by masking spectrograms' evidence. Rising above the air ends the difficulty.

Rockets are giving astronomers higher vantage points, at altitudes ranging from 60 miles—where the daytime sky becomes dark as night and the stars shine out brightly—up to several hundred miles. They have carried aloft a four-inch telescope, spectrographs, cameras, other instruments. Findings are telemetered to the ground, or retrieved from parachuted nose cones. Their brief glimpses, before they plunge back to earth, have sufficed for fascinating discoveries reported by Dr. Herbert Friedman and fellow scientists of the Naval Research Laboratory.

Around the star Spica, rockets find a mysterious aureole of blazing light, extending nearly a quarter of the way across the heavens. If human eyes could see it, the luminous display would be a brilliant feature of the night sky, outshining moon and stars. Actually it glows with invisible far-ultra-violet light—detected and mapped by rocket-borne instruments called photon counters. This sky glow, and several others like it, were a recent surprise discovery. Seeking their unknown cause may reveal unsuspected physical forces at work in the stars.

From a 123-mile height above White Sands, N. M., early last year, a special camera in an Aerobee-Hi rocket took the first photo of the sun by far-ultra-violet light. Above-the-air observations show that it shines more brightly in this "color" than any other. They also detect bursts of powerful X-rays from the sun—possibly a principal cause of radio blackouts, for which the sun's ultra-violet rays have been blamed before.

These exploits illustrate what may be sky observatories' greatest gift to astronomers: For the first time, they open to view the whole gamut of the stars'



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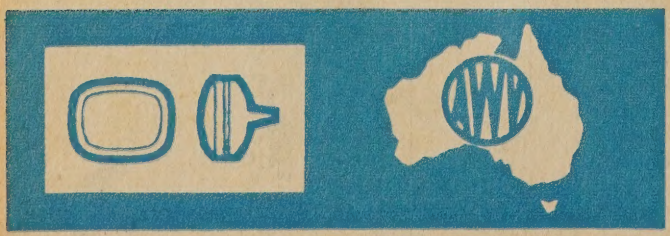
*Another approach to the problem. This special camera housed in the nose cone of a rocket was hurled 123 miles above the earth to take the first ultra-violet picture of the sun. From it, scientists have learned much about the sun's behaviour.*

☆

# THE MAN SAID REPLACE IT WITH A NEW RADIOTRON PICTURE TUBE

I'm a housewife, and, contrary to what my husband thinks, I'm busy for the best part of the day. Even when the TV set is turned on I still have my work to do. For that reason the thing I disliked about our old picture tube was the length of time it took to warm up, a big part of my time was spent waiting for a picture to appear (even more annoying when the sound arrived ages before the picture did).

Now that we have to get a new picture tube, I told the Serviceman that I wanted the one with the shortest possible warm-up time. The Serviceman said that the one tube on the market with a warm-up time of less than a quarter of a minute was, in his opinion, the most reliable one, and was just what I wanted. Well, naturally, I said, "yes!". So the man said, *"Replace it with a Super Radiotron Picture Tube."*

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Through most of astronomical history an observer's view of space has been limited to an "optical window" encompassing the visible and near-visible rays that penetrate the atmosphere. Another peephole into space, the atmosphere's "radio window" for the shortest radio waves, was discovered in 1932. Since then, radio astronomy has expanded our knowledge of the universe as much as past centuries of optical astronomy.

Now, all at once, sky platforms fling open every other kind of "window". All the hidden radiations leap into view—gamma rays, X-rays, the far ultra-violet, the far infra-red, the longer radio waves. Suddenly astronomers find utterly fabulous advances within their grasp. A golden era of discovery has opened for them.

Satellite observatories, operable 24 hours a day in night-dark space, will prolong the view that rockets get only fleetingly. Multipurpose U.S. and Russian satellites already have made some ultra-violet and cosmic-ray observations. Coming next and soon are satellites designed especially for astronomy. Plans to launch a series of them, beginning in 1962 or 1963, have been announced by the National Aeronautics and Space Administration.

## TENTATIVE DESIGNS

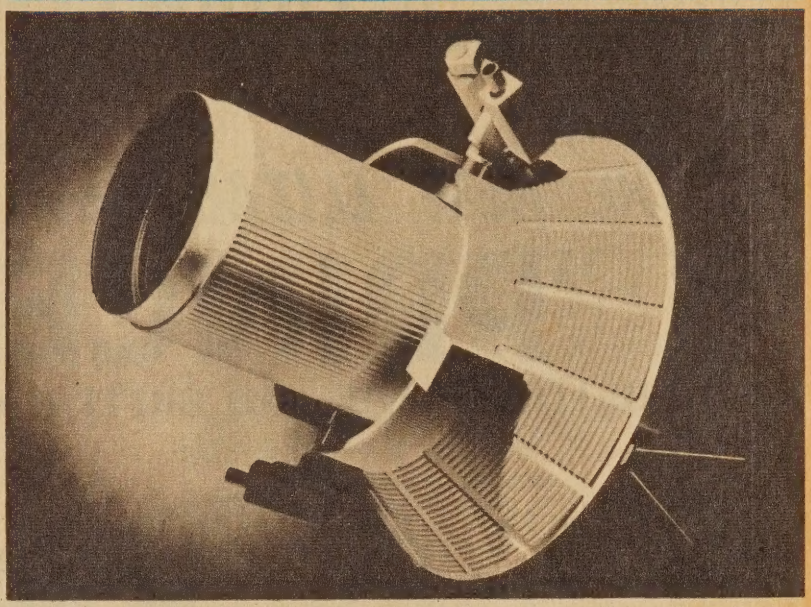
Tenative designs, of one-to-two-ton weight, wield telescopes of 24-inch size and up. Pressing every advantage of airless space, astronomical satellites will have optical telescopes for the ideal seeing by visible light; and a varied array of instruments to pick up the "new" radiations, observable only above the air.

What satellite telescopes see, can be relayed directly to earth by TV technique—the method now considered most promising. Or photos could be made, for later radio transmission.

Tempting targets for space telescopes include the mysterious Great Red Spot on Jupiter—more of a mystery than ever, since grinding and rumbling radio noises were recently traced to its vicinity; and Saturn's famous rings, once thought to be made of rock fragments but now believed to be of snow.

Satellite observatories are expected to spot nonsolar planets, quite possibly inhabited by intelligent beings, that are suspected to be orbiting around some nearby stars—like one called 61 Cygni —from wobbles in those suns' motions.

# PROJECTED 50-INCH TELESCOPE



***The United States Kitt Peak National Observatory has shelved plans for the world's largest earth-bound telescope in favour of 50-inch type to be placed in fixed orbit about 22,000 miles above the earth. Above is a model of the telescope based on present plans.***

So far will space telescopes outrange earthbound ones that they may see to the very edge of the universe.

Astronomers themselves will later eye the skies from manned satellites. And the ultimate step, officially announced as a long-range NASA objective, will be an observatory on the moon; it will offer a stable foundation for a telescope of unlimited size, with no atmosphere to hamper observations.

The moon, meanwhile, has become the first conquest of a rival kind of sky adventuring — go-there-and-see astronomy. What the moon's far side looks like was finally revealed, last October, when Russia's Lunik III space probe photographed it at close 40,000-mile range, developed the photos, and radioed them to earth—a dazzling exhibition of rocketry and instrumentation.

Coming U.S. and Russian astronomical expeditions into space may be expected to reconnoitre Mars and Venus, land seismographs and other instruments on the moon, and, later, bring back tangible samples of the surface of the moon and planets.

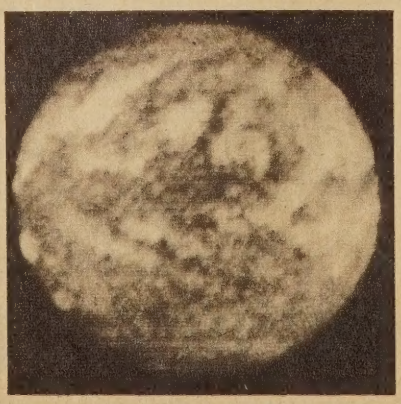
But so many celestial objects of interest lie outside our solar system—and beyond the imaginable range of a "go-there-and-see" space vehicle within anyone's lifetime — that telescopic observation will remain the major tool of astronomy. And it will reach its highest development, score its greatest discoveries, in the new observatories above the atmosphere.

How sure astronomers are of this is dramatically shown by a recent change of plans for the great Kitt Peak National Observatory under construction in Arizona. Its long-range program was to have provided it with a telescope of several hundred-inch size, perhaps the world's largest. Now that has been shelved, the National Science Foundation reports, in favor of "a new and exciting project, the design, construction, and operation of a large orbital (satellite) optical telescope."

## 50-INCH MODEL

The national space telescope will be a grand-scale one. Going beyond plans for early astronomical satellites, it is expected to be of 50-inch size. It will make observations on command from the ground and communicate them back to earth. Put into orbit at about 22,000-mile altitude, so as to circle the earth in just 24 hours, it will keep pace with the earth's rotation — and hover permanently above its control point on the ground.

Planners emphasize that the Kitt Peak space telescope is years away. It will be enormously expensive. But they have high hopes that it will eventually be the national observatory's principal spectacular piece of equipment—available, like Kitt Peak's other telescopes, to all qualified U.S. astronomers.



***Some of the results obtained so far. At left is a superb picture of a sunspot, made with the 12in telescope at an altitude of 15 miles. At right is the ultra-violet picture of the sun made at 123 miles.***

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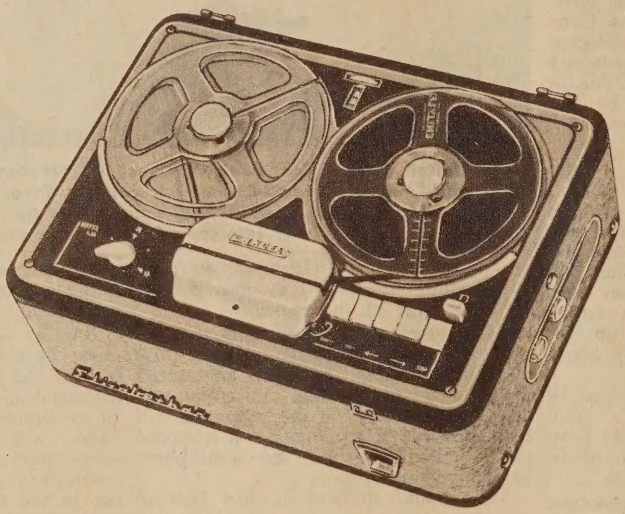

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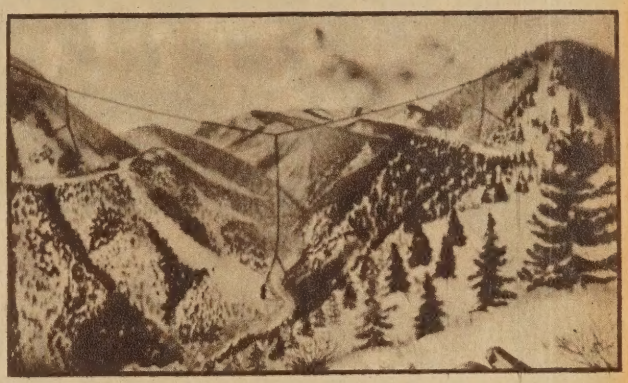
# VLF WILL BOOST WWV ACCURACY

**Most radio enthusiasts have heard of WWV, the US frequency and time standard transmitter, and many make good use of the transmissions to check their own standards. However, due to propagation variables, these transmissions are not always accurate enough for the most precise measurements required by today's scientists. In an effort to provide even greater accuracy, the National Bureau of Standards are now broadcasting their time signals from a unique, very low frequency transmitter in Colorado.**



*Artist's impression of the 20 Kc aerial stretched across Sunset Canyon. The copper coated steel cable weighs more than a ton, is 3,400ft from anchor to anchor, and 900 feet above the canyon floor.*

THE bureau is now broadcasting a standard of radio frequency from a new station in the Rocky Mountains at the very low frequency of 20 Kc. Broadcasting began April 5 from Sunset Canyon, about 20 miles west of Boulder, Colo. Within their range, these signals will substantially increase the accuracy of the NBS standard frequency broadcasts.

Signals from the Sunset Canyon station (call letters WWVL) may reach as far as Hawaii—perhaps even to New Zealand—but they are not strong enough to provide good coverage over the entire globe. However, WWVL is only the first step toward eventually providing worldwide broadcasts at 20 Kc.

Both time signals and the national standard of frequency are currently transmitted on a worldwide basis by the bureau's two shortwave stations, WWV at Veltsville, Md., and WWVH on Maui, Hawaii. These signals are propagated by alternate reflections between the earth and the ionosphere to reach the receiver. But the height and density of the ionosphere change constantly and this creates small, erratic changes in the speed of the radio waves.

Errors introduced by these changes were insignificant 10 years ago. Today, however, it is increasingly important to measure both time and frequency with greater and greater precision in order to co-ordinate the recordings of tracking stations for missiles and satellites, to measure minute quantities of electrical and radio energy in basic research, and to facilitate development in the field of electronics.

The low-frequency waves from Sunset Canyon will follow the curvature of the earth with the ionosphere and the ground acting as upper and lower limits of a gigantic duct to guide the signals over the globe. As the ionosphere will serve only as a boundary, not a direct reflector, it will have almost no effect on the speed of the waves. For this reason the 20 Kc frequency will provide a much more stable transmission than the shortwave frequencies of WWV and WWVH.

The Sunset station is the result of several years of effort and several more years will be required before a true global transmitter is on the air.

Many investigations, by such men as J. A. Pierce at Harvard, have shown that very low frequencies can transmit standard signals over long distances with great accuracy. A study in 1958 by A. D. Watt and R. W. Plush of the NBS Boulder Laboratories, indicated that the 20 Kc frequency was the most efficient to transmit a standard frequency on a global basis.

Radio waves, however, are not bound by international boundaries and use of the different frequencies must be approved by both national and international organisations. In January of 1959, the bureau recommended that the 20 Kc frequency be adopted by the U.S. group of the International Consultative Radio Committee (CCIR). CCIR adopted the proposal in April, 1959, and in December, 1959, the International Radio Conference at Geneva, Switzerland, adopted the 20 Kc standard frequency band for the International Telecommunications Union (ITU).

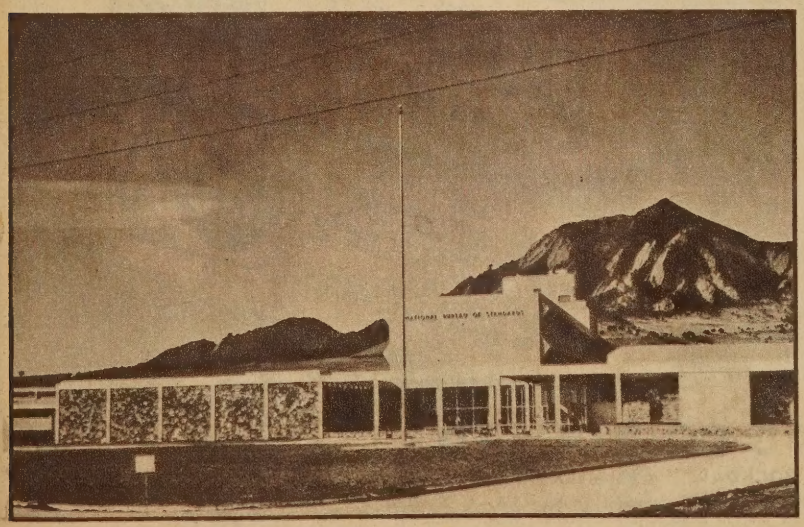
## NEW SERVICE

In January of this year, the U.S. Government's Interdepartmental Radio Advisory Committee (IRAC) approved a bureau application to operate a 20 Kc standard frequency broadcast and the new service was registered with the ITU. This action automatically placed a deadline into effect as international agreements specify that a valid registration requires a station to be in operation within 90 days after the application is approved.

To meet this deadline—and to rapidly and economically provide a better frequency standard for as large an area as possible—the bureau modified an existing antenna in the Rocky Mountains. The antenna was previously used for low-frequency ionospheric research, whistlers and VLF emissions.

Although almost every division of the Boulder Laboratories was involved in determining the best frequency, obtaining the site, adapting existing transmitters to the job, and other tasks, prime responsibility for the Sunset development rested on a group headed by W. D. George, W. W. Brown, A. H. Morgan and D. H. Andrews.

The antenna is a copper-coated steel



*The new National Bureau of Standards radio propagation laboratory at Boulder, Colorado, about 20 miles from the WWVL transmitter. Most of preliminary investigation into VLF propagation and the development of the present transmitter was carried out here.*

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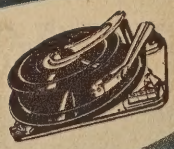

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cable stretching more than half a mile across the top of Sunset Canyon, more than 900ft above the canyon floor. From the centre of the cable another cable was dropped to a 20 Kw transmitter at the canyon floor. This assembly forms a top-loaded antenna with the canyon walls acting as giant supports to hold the cables above ground. The tremendous size is necessary because of the great length of a 20 Kc radio wave (each wave is almost 10 miles long, whereas television waves, by comparison, range from about one to 16ft).

Currently, users of WWV can, in a few hours, use the shortwave signals to measure frequency to a few parts in 10 to the 7th. Users within the range of the WWVL Sunset station (several thousand miles) will be able to make measurements about a thousand times better —to 1 part in 10 to the 10th.

Initially the 20 Kc signal will serve only as a frequency standard. Before the signal can be used to measure time intervals, such as a millionth of a second, new equipment must be built that will modulate the signal so that a particular wave can be identified at both the transmitter and the receiver. This is more difficult at very low frequencies because of the length of the waves involved. Research is being conducted to determine the best methods of cycle identification and time signa modulation.

## MORE EFFECTIVE

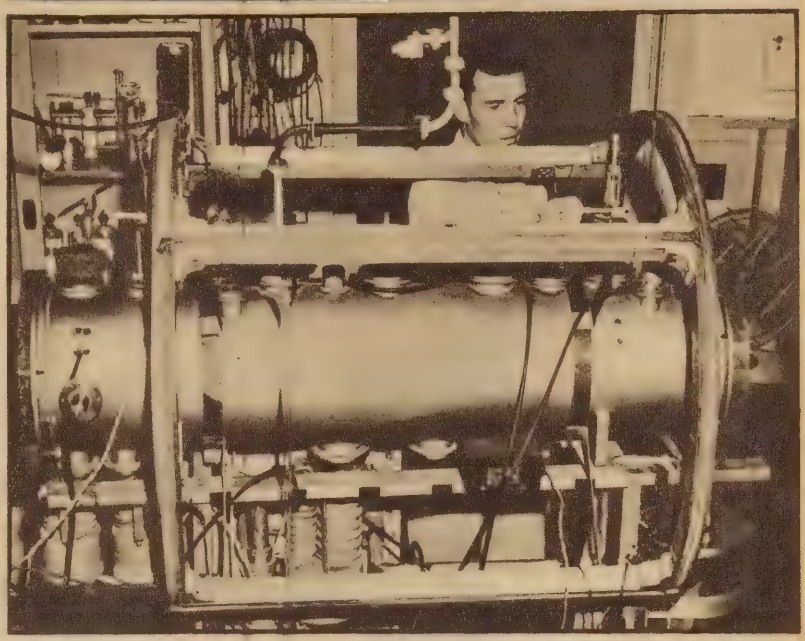
The original signal will be used primarily by research organisations in studies to prepare for the eventual worldwide transmitter. Within a year the bureau plans to build a pilot station (for the global transmitter) on the plains of Colorado and to transfer the Sunset equipment to the pilot site. The pilot station will be much more effective because it will be on the plains and will also have higher power, but will require the building of tall towers to support the antennas. In addition to the 20 Kc signal, the pilot station will also transmit a strong 60 Kc signal.

To meet as many needs as possible for a better frequency standard within the United States, the Boulder Laboratories began broadcasting experimental, low-power, 60 Kc signals in 1956. Because of their low power, these signals are not well received at distant points and their use is limited.

However, more than 50 organisations, from coast to coast, have been using the signals during the past two years and have obtained from 10 to 1,000 times better precision than they received from the shortwave broadcasts. Because of the reliability and accuracy of these signals some organisations have been able to cancel plans for installing expensive atomic frequency standards within their own laboratories.

Both the 60 Kc signals and the shortwave broadcasts will continue even after the global 20 Kc transmitter is put in operation. The global station will provide standard time interval and frequency signals which will be accurate anywhere in the world to a few parts in 10 to the 10th for measurements made in a short period, and will thus serve U.S. possessions and bases overseas. The 60-kc broadcast, however—when its power is increased—should provide even better service within the United States (accuracies to a part in 10 to the 11th). It is also relatively easy to modulate the 60 Kc signals but this frequency is too high to be particularly effective beyond the continental limits of the United States.

# CLOCK THAT IS RIGHT ON TIME



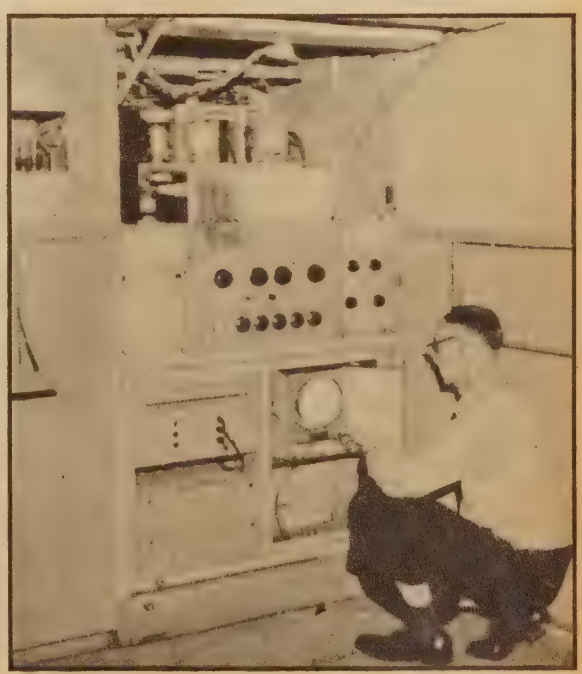
***This is an atomic beam clock developed by the NBS in an effort to provide the highest possible accuracy in time measurement. Depending on a discharge of cesium atoms which move down the cylinder from left to right, it is capable of an accuracy of 1 second in 300 years.***

The range and accuracy of the 20 and 60 Kc signals are critically needed by such groups as the U.S. Air Force, the National Aeronautics and Space administration; the Atlantic, Pacific and White Sands Missile Ranges; and the Smithsonian Institution (for satellite tracking). The special receivers, however, which are required to pick up these low frequency broadcasts cost several thousand dollars.

For this reason the shortwave broadcasts of WWV and WWVH will always be of value. They require only the simplest receivers and their accuracy is sufficient to meet the current needs of television and radio stations, electric power companies, amateurs, smaller businesses and the general public.

In fact, the WWVH broadcasts should be improved by the initial Sunset transmissions. If the Sunset signal extends to Hawaii as expected, it will be used to control the WWVH transmissions and thus increase their accuracy from ten to one hundredfold.

☆



***Another part of WWV is this timer which controls the once-every-minute broadcast of the WWVL call sign. Here it is being adjusted by engineer Howard Williams, who operates the Sunset Canyon transmitter.***

☆

*The connection between colloids and surgery may seem remote at first, but the surgeon's fine rubber gloves are made by electro-deposition of finely divided rubber particles in solution—that is, a colloid.*

# Colloids — Mixtures of Vital Importance

**Whether or not we know what colloids are, they are rather vital to our existence. Without them, we would have the greatest difficulty in washing, adorning, clothing and feeding our bodies. In fact, we probably wouldn't have bodies, either, because our very life's blood is a colloidal liquid!**

by Calvin Walters

THERE is a saying which asserts that "it is the little things in life that count." This noble assertion did not, of course, have its origin within the ambit of our present subject but it has an application there for all that.

## LITTLE THINGS FIRST

Without the little things of nature there can be no big things, for everything both animate and inanimate consists of large numbers of little things. Even the little things consist of "littler" things down to the things which constitute the atomic nucleus.

And what about the things contained in the atomic nucleus, the neutrons, protons and so on? Do these consist of smaller things? Is energy made up of a lot of little things?

How far can we go with subdivision of particles? Do we reach an end point or is it like the saying "bigger fleas have little fleas upon their backs to bite 'em and little fleas have smaller fleas and so ad infinitum?"

Scientists have, for centuries, being trying to subdivide matter into smaller and smaller units. In some cases the results have been explosive, culminating in the nuclear bombs. In other cases the results have been surprising and the resultant applications have been of great benefit to the human race. In this category is the colloid particle.

Before we go any further it may be as well to define just what a colloid particle is.

When any kind of matter at all is reduced to fine submicroscopic particles it behaves in a peculiar manner and acquires unusual properties.

## THE COLLOIDAL STATE

Any substance reduced in size so that it exhibits such characteristics is a colloid particle. It will be seen, therefore, that the term colloid does not indicate any particular substance. Rather does it indicate the state in which a substance exists. So then, colloid chemistry is the study of the chemical and physical behaviour of particles in an extremely fine state of subdivision.

The importance of the colloid state can be seen when it is realised that without it there can be no soap, milk, cream, cheese, paint, explosives, smoke, dust, fog, rubber goods, dyeing and showerproofing of fabrics, fertilisers, mayonnaise, hair cream and other emulsions.

There could be no ceramics, celluloid, detergents, plastics, confectionery, electroplating, lime mortar, cement, metal alloys and so on. In fact, the colloid has such a widespread application that, without it, there would be practically nothing, even us.

To become a colloid, a substance has to be reduced to very, very small particles indeed. The smallest colloidal particle is round about one millimicron in diameter. As a micron is one 25,000th of an inch and a millimicron is one-thousandth part of this, it will be seen that a colloidal particle can be very minute.

Almost any substance can be reduced to such a size by grinding or dissolving in some suitable solvent. Other substances occur in nature in a colloidal state.

Among the latter are milk, rubber latex, gelatin, blood, white of egg, bentonite clay, starch, germs and viruses, vitamins and protoplasm.

A characteristic of most substances which are not soluble in, say, water is the formation in the bottom of a container of sediment after the substance has been mixed with the water. This sediment is formed by the force of gravity pulling the substance down.

If the same substance has been ground to colloidal dimensions and again

# COLLOID WE COULD DO WITHOUT

mixed with water it will not sink to the bottom at all but will remain indefinitely in suspension. This is a characteristic of all colloidal particles and is the basis of the manufacture of emulsion.

In this phenomenon lies an apparent paradox in that, somehow, the particles resist the natural force of gravity.

This failure of colloid particles to settle out of solution is a very important one from the point of view of many manufacturers.

For many years this phenomenon was not understood. It was not until the invention of the microscope and later the ultra-microscope that any idea as to the cause of the phenomenon began to be formulated.

In the year 1827, an English botanist Robert Brown noticed that grains of pollen immersed in water executed constant vibratory movement. This movement was later found to be a characteristic of all colloidal substances immersed in a liquid and has since been referred to as the Brownian Movement.

In the years which followed, much speculation was entered into regarding the cause of this movement.

Brown himself thought that it was a phenomenon characteristic of life until he found that the same movement occurred in a powdered piece of an Egyptian sphinx!

Others thought that the movements were caused by convection currents but this idea was abandoned after many tests. That external vibrations were the cause was disproved after extensive tests in cellars and open fields.

## MOLECULAR BOMBARDMENT

It has now been shown that the movement of the particles is caused by their bombardment by the rapidly moving molecules of the liquid in which they are suspended.

These collisions are able to throw the colloidal particles around with sufficient force to prevent them settling to the bottom.

As the particles increase in size the unequal bombardment diminishes until, when the particles reach a size of about three microns (three 25,000ths of an inch) the movement ceases. At the smallest size of a colloidal particle the movement is violent.

We now come to a very important feature which is the outcome of these molecular collisions with the colloidal particles.

It is well known that friction of a moving body against another will build up a charge of static electricity on the surface of the moving body. This is often of considerable magnitude.

A well-known example of this is the rubbing of a comb through the hair, when crackling of minute sparks can often be heard.

The friction caused by a motor car against the air often causes a charge to be built up in the body of the car. At the toll gates of some bridges, as for instance the Sydney Harbour Bridge, metal wires are embedded in the road which conduct the charge away when the car brushes against them. The same purpose is served by the chain dragging on the ground behind petrol waggons.

These charges of electricity are caused by the transfer of electrons from one of the bodies to the other and may be either negative or positive according to whether the body loses or gains the electrons. The body which loses becomes positive and the one which gains becomes negative.

***Smog: the combination of man-made smoke and natural fog gives us the colloidal mixture we know as smog. London is well known for its smog, but this picture was taken in Sydney, just to show that it is no respecter of places.***

Another fundamental principle of electricity to remember is that bodies with like charges repel each other and bodies with unlike charges attract each other.

To return to our colloidal particle we remember that it is in constant movement because it is being bombarded by the molecules of the medium in which it is suspended.

This movement by collision causes the particle to become somewhat heavily charged with negative electricity so that all particles, being charged with the same negative electricity, will repel each other. This also assists in preventing the particles from settling to the bottom, because each one is being repeatedly repelled by those beneath.

A more important result is that where particles are of a sticky nature such as glues, milk and rubber latex the repulsion of one particle from another prevents them from adhering together in a solid mass.

The fact that colloidal particles assume a charge of electricity or are ionised, as it is termed, has made it possible to

☆

***And while ever we have chimneys like this we will have smog. Fortunately, colloidal particles have an electrical charge, enabling them to be drawn to a positively charged surface. Giving the walls of a chimney a positive charge allows the particles to be collected before they are belched forth into the air. It even permits important by-products to be salvaged.***

☆

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| R.F. Coil, 1-3/8in round can. Special High Q | | 8 | 5 |
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| R.F. Coil, ¾in. square miniature can. Bakelite paper former | | 6 | 7 |
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develop some useful techniques, for it has enabled the technician to control the movement of the particles so that he can cause them to move in any direction required.

Up to a few years ago it was the custom to make such high quality goods as surgeons' rubber gloves by moulding in presses.

Today such articles, of far superior quality, are electro-deposited by making use of the negative charge possessed by the colloidal rubber latex solution.

In this process an anode (positive electrode) is made in the shape of the required article and placed in the rubber solution together with a cathode (negative) electrode.

Current is allowed to flow, whereupon the negative rubber latex particles will be attracted to the positive (anode) electrode. The longer the current flows, the more rubber is deposited on the anode. When this layer is of the correct thickness, the anode is removed and the article stripped from it. Layers up to one-quarter of an inch are possible.

## OBJECTIONABLE COLLOID

Smoke, smog and soot are a menace in large cities. Being colloidal particles suspended in air they form a continuous unhealthy blanket in the atmosphere. The charged nature of the particles has made possible a device for dealing with these particles in flues and chimneys before the contaminations reach the atmosphere.

The walls of the chimney form the positive electrode with a wire passing vertically up the flue acting as the negative electrode. As the negatively charged particles pass up the flue the positive walls attract them to itself. The particles then fall to the bottom of the flue into a container.

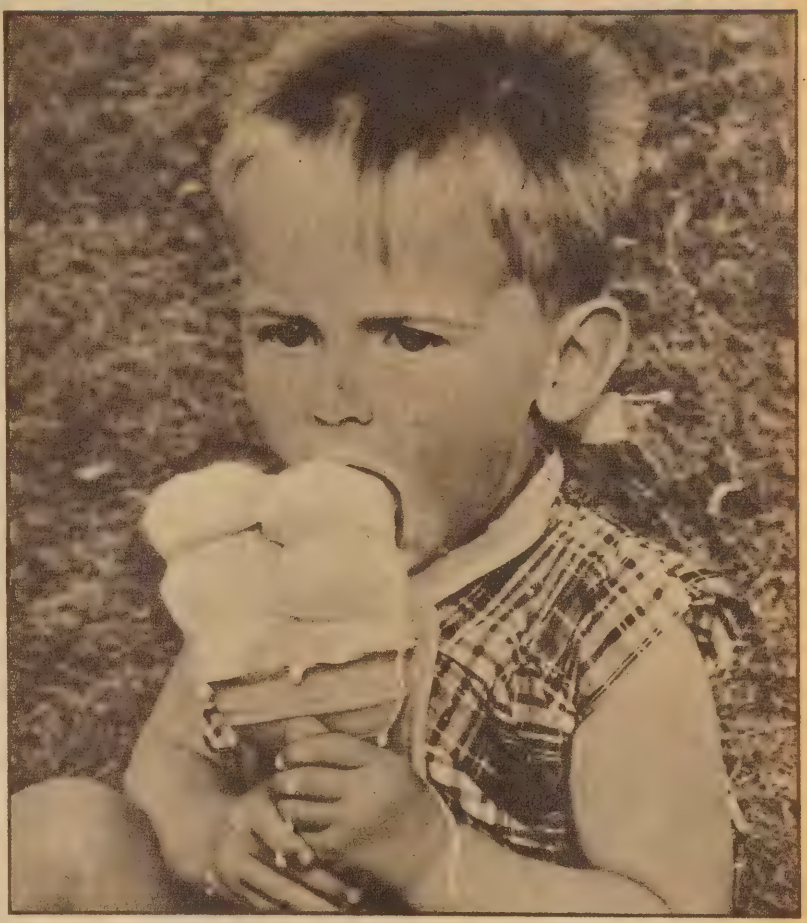
This method has also proved of value in extracting valuable by-products from the smoke such as sulphur, which would otherwise be wasted.

Perhaps one of the most important applications of colloid chemistry lies in the principles of emulsification.

When one talks about emulsions he is likely to be interpreted as meaning those horrible concoctions of fish oil which mamma forced down our throats during our growing period. Some kids liked them. Most didn't.

Emulsion embraces a far larger field than that. It includes the principles of washing and laundering, ice-cream, face creams, salad dressing, mayonnaise, ointments, paints, varnishes, insecticides, all of widely different uses, but all of which are colloidal particles dispersed in a different medium such as oil or water.

# IT'S JUST ICE-CREAM TO ME



*How much ice-cream can one boy eat? Any "given" amount, it would seem, judging by the "do or die" expression on this youngster's face. He doesn't know it, of course, but this most popular delicacy depends on the phenomenon of colloids.*

*"Illustrate soap," said the Editor, and how better than this? But, seriously, soap is very important. Without soap there would be no soap operas. Without soap operas there would be no commercial radio and TV. And without commercial radio and TV we wouldn't be so worried about soap. (By the way, it's a colloid too.)*

The principles involved in the art of emulsification are rather involved and technical and therefore difficult of simplification of explanation. At the risk of being "trod on," I am going to try to give some sort of general idea of what takes place when such widely different substances as oil and water are induced to mix.

Water is a substance which possesses remarkable electrical properties. The molecules of water have a strong attraction for one another. The inner molecules have such an attraction for those at the surface of a drop or puddle of water that they tend to draw the outer ones inwards. That is why a drop or puddle or the edges of water in a tumblerful assume a rounded appearance.

The inner pull forms a "skin" on the surface which it is comparatively difficult to break. That is why water spilt on a floor forms long streams with rounded edges or why an insect is able to stand on the surface of a pond. This property of having a "skin" is called surface tension.

The molecule of water also has strong electrical properties in that it can be separated into positive charges and negative charges. In other words it is a

(Continued on Page 141)

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# ABOUT THIS DECIMAL BUSINESS!

**It is tacitly assumed by many that the adoption of a decimal coinage system will ensure substantial and quite automatic savings. This writer isn't so sure. In fact, he concludes, "Don't disturb the coinage on my account."**

I WAS interested to read Mr Michel's article "Will Decimals Replace £.s.d." (R. TV and H., August, 1960). For my own part I have to say, "It was a pity about that article." Not Mr Michel's, but another one, which appeared a number of years ago in the old "Federal Accountant."

Like most mathematically inclined people, I had got around to asking myself what we had done to deserve such a clumsy coinage, and why we put up with it anyway. It was a pity about that article.

## DISILLUSIONMENT

Had I never read it I might have gone on peacefully hating the coinage for the rest of my life. But this writer, whose name I have long since forgotten, said, "Careful with the Coinage," and supported his arguments with dramatic examples like the following:

What is the cost of 237 articles at 3½d each?

Well, 240 at 3½d = £3½ = £3/2/6
3 at 3½d = 9½
237 at 3½d = £3/1/8½

"Is it any easier," he asked, "—is it as easy—to calculate the cost of 237 articles at 3½ cents?"

I read all this, was greatly impressed, and promptly forgot about it. Or thought I forgot about it.

Years later when we started seriously to consider a change of decimal coinage, I found myself unable to accept at face value the cries that went around: Free us from the burden of arithmetic—make life easier for the housewife, the shopkeeper—save hundreds of thousands of pounds a year in clerical costs — free schoolchildren to study more important things.

On the other hand, I had not the slightest idea how to go about analysing the question, and nearly fell into the error of concluding that a decimal system MUST be better because there are 100 parts of the main unit instead of 240—a proposition which, if you look at it carefully, makes not the slightest bit of sense.

## THE PROBLEM

It seemed to me, eventually, that the problem resolved into three parts.

(1) If we had a decimal system, would the average person indeed find the burden of his day-to-day tasks any easier.

(2) If so, what would be the cost of changing over and,

(3) For comparison with the cost, can we put a price on the savings.

The pursuit of these lines of inquiry leads a very long way, but here, briefly, is what I conclude:

We do four things with quantities of money:

Add them together: (a dozen eggs at 5/6 and a pound of butter at 4/5½ makes 9/11½ in all).

Subtract them from one another: (give the grocer £1, the groceries cost 9/11½, expect 10/0½ change).

Divide quantities into them: (four apples to the pound at 1/9, equals 5½d per apple).

Multiply them by quantities: (42 hours worked this week at 9/6½ an hour equals £20/0/9.

The picture starts to be a little clearer. By studying each of these operations (no very difficult task) we can arrive at a definite conclusion about whether or not decimal money saves time—and let me tell you here and now that it does.

Consider first of all the following sums:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Add | £0 | 5 | 7 | | Add | $.57 | | |
| to | 0 | 2 | 1 | | to | 0.21 | | |
| | 0 | 7 | 8 | | | 0.78 | | |

The left-hand sum requires two operations:

(1) Add 1 and 7,
(2) Add 2 and 5.

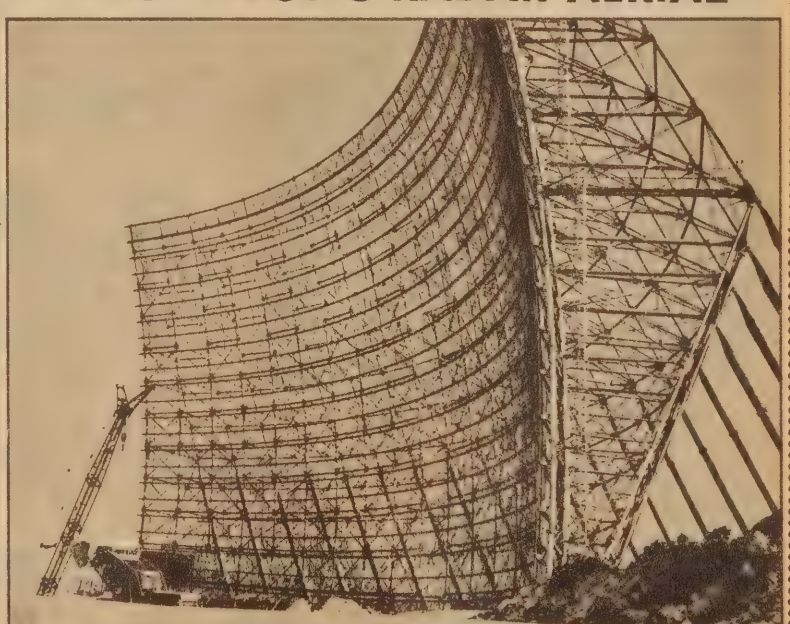
Thus, "two operations" is a measure of the labour involved, and if we now consider the right-hand (decimal) sum we find that it also requires two operations.

Now compare the following in the same way:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| £0 | 5 | 7 | minus | £0 | 2 | 1 | | |
| £0 | 3 | 4 | × | 2 | | | | |
| £0 | 10 | 8 | divided by | 2 | | | | |
| $5.07 | | | minus | $2.01 | | | | |
| $3.04 | | | × | 2 | | | | |
| $10.08 | | | divided by | 2 | | | | |

These exercises establish that in very simple calculations there is no difference

## HUGE ARCTIC RADAR AERIAL



*ANTENNA reflector, larger than a football field, erected as part of the United States Air Force's Ballistic Missile Early Warning System (B.M.E.W.S.).*

*The super power radar system is designed to detect possible intercontinental ballistic missiles as they rise over a horizon thousands of miles away. When in operation, the B.M.E.W.S. Surveillaance Radar Sub-system will generate a giant curtain of radio frequency energy over the northern polar region, and will provide the American defence units with about a 15-minute warning in the event of a missile attack anywhere on the North American continent.*

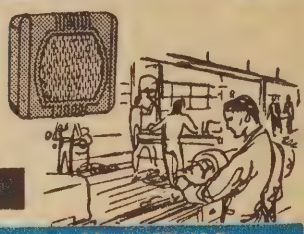
*The antenna reflector towers 165ft into the Arctic sky. The reflector's surface is made up of 2,240 five-by-seven-foot steel screen panels, bolted to the truss structure. The 400ft long structure is built to withstand a six-inch coating of ice in winds of 185 miles per hour.*

# FOREMOST IN SOUND . . .

COMMUNICATION

ENTERTAINING

PAGING



INSTRUCTING

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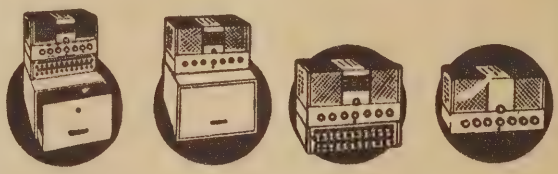

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at all between decimal currency and traditional.

Now consider something a little more complex.

| | |
|---|---|
| $241.68 | £24 16 8 |
| 171.77 | 17 17 7 |
| 841.95 | 84 19 5 |
| 1,255.40 | 127 13 8 |

(Please note that to make the test valid, there is exactly the same numreb of digits in each example.)

The decimal sum requires 13 operations.

(1) add 5 and 7,
(2) add 8 to that.

That comes to 20. Write down 0 and carry 2:

(3) add 2 and 9
(4) add 7 to that,
and so on.

The traditional sum, on the other hand, requires 16 operations; there are the same number of digits to add together but—

## COMPARISON

(1) with decimal quantities, the process of working out what number to write down at the foot of each column and what number to carry forward is so simple that it may be ignored (total of the second column is 24: carry 2 and write down 4).
The traditional sum, of course, consists in the main of decimal quantities too, but it has two columns of non-decimal quantities: the pence column where we must divide the total by 12 instead of 10, and the ten shillings column where we divide by 2 instead of ten, and I think we should count this as 2 extra operations.

(2) The column of ones in the decimal sum does not produce a carry-forward figure. The column of ones in the traditional sum does produce a carry-forward figure and so one more digit to add.

Thus, in a sum of this kind, decimal money with its 13 operations saves 3 operations over traditional money with its 16. Similarly, we find that £24/16/8 x 2 requires 7 operations, while $241.68 x 2 requires 5, a saving of 2. The following require 6 and 5 operations:

| | |
|---|---|
| £24 16 8 | $241.68 |
| 17 17 7 | 171.77 |
| 6 19 1 | 69.91 |

## SHORTER IN PRACTICE

(As a matter of fact, anyone experienced at arithmetic would subtract 17/ from 16/ in one operation, and not as two separate operations (7 from 6, 2 from 1) so that the numbers of operations become 5 and 5).

£24/16/8 divided by 5 requires 7 operations, $241.68 divided by 5 requires 5.

Now consider something more difficult again:

| | |
|---|---|
| $2,468.57 | £2,468 5 7 |
| 7,740.63 | 7,740 6 3 |
| 8,111.18 | 8,111 10 8 |
| 2,171.14 | 2,171 1 4 |
| 7,122.34 | 7,122 3 4 |
| 6,666.66 | 6,666 6 6 |
| 2,345.67 | 2,345 6 7 |
| 4,646.46 | 4,646 4 6 |
| 2,614.20 | 2,614 2 0 |
| 43,886.85 | 43,885 6 9 |

The decimal sum requires 51 operations, the traditional requires 53, still a difference of only 2.

# JET FEATURES POWER STEERING

*AN electronic power steering system has been developed for the U.S. Air Force's newest supersonic jet, the Republic F-105 Thunderchief. Built into the nose wheel of the fighter-bomber, the system is said to make steering the jet—which takes off and lands at speeds between 150 and 200 miles an hour—as "easy as steering the family car."*

*The assembly consists primarily of two potentiometers, a transistorised amplifier, a servo-mechanism and a hydraulic unit and structural linkages.*

*When the pilot nudges the rudder pedal, this signal is picked up by one potentiometer, amplified and fed to the servo that turns the wheel. The other potentiometer measures the change and relays the information back to the servo when it's time to "close the loop." The entire sequence is accomplished within thousandths of a second.*

*Republic's design safety engineers said conventional mechanical steering systems were too slow to cope with the high-speed landings and take-offs of the supersonic aircraft. A half-second delay in responding to the pilot's signal, or an infinitesimal amount of "play" in the steering arrangement would mean the jet would plunge off the runway.*

*The new system, which the pilot can override and thereby operate manually, at lower speeds, if he desires, guarantees complete control of the jet on the ground at all times.*

The following require 6 and 7 operations:

| | |
|---|---|
| $7,740.63 | £7,740 6 3 |
| 2,468.57 | 2,468 5 7 |
| 5,272.06 | 5,272 0 8 |

$2,468.57 divided by 473 requires 17 operations; £2,468/5/7 divided by 473 requires 27.

$2,468.57 times 7 requires 6 operations; £2,468/5/7 times 7 requires 9.

Thus, decimal money does offer some saving of clerical effort, but except in the case of long division the saving does not appear to be great, and in the case of the simpler calculations, there is no saving at all.

Turning now to (2), the cost of changing over, one finds a new, complex problem. There are bookkeeping machines, cash registers, adding machines, petrol pumps, computing scales, and other devices by the thousand to be converted or scrapped.

The confusion and inconvenience of the transition period must cost something also. But just how much? That is anybody's guess. One hears people who should know putting the price at £100 million. My own guess, based on the South African experience, is £30 million. It seems safe at any rate to say "not less than £30 million." Now let us calculate, if we can (3) what we are likely to save.

Well, how much? Frankly, I haven't any idea, but consider the following

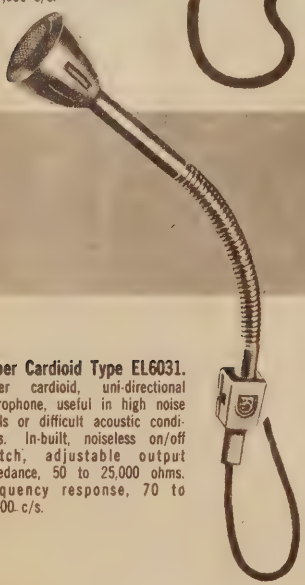
**(Continued on Page 101)**

# Which PHILIPS microphone is best for your purpose

**Dynamic Type 1100 or 1101.** Here is a robust, general-purpose microphone giving reliable service and excellent intelligibility even under high-ambient noise levels. Available in 50 ohms. or high impedance. Frequency response, 100 to 7,000 c/s.

**Dynamic Type 1114 or 1115.** Recommended for tape recording and general stage work. Styled for hand use or stand mounting. Frequency response, 100 to 10,000 c/s.

**Pencil Microphone Type 1116 or 1117.** Ideal for general studio use (for roving and orchestral pick up) and all applications requiring a high-quality microphone. Frequency response, 35 to 15,000 c/s.



**Hyper Cardioid Type EL6031.** Hyper cardioid, uni-directional microphone, useful in high noise levels or difficult acoustic conditions. In-built, noiseless on/off switch, adjustable output impedance, 50 to 25,000 ohms. Frequency response, 70 to 15,000 c/s.

**Omni-directional Type EL6021.** A non-directional, moving-coil microphone for recording, broadcasting and all high-quality P.A. systems. In-built, noiseless on/off switch. Adjustable output impedance. Frequency response, 60 to 15,000 c/s.

**Moving Coil "Pencil" Type EL6040.** For highest quality broadcasting and stage work. In-built, noiseless on/off switch and adjustable output impedance, 50, 500, 25,000 ohms. Frequency response, 35 to 15,000 c/s.

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# Technical Review

## "TUTOR"—MACHINE THAT TEACHES AND EXAMINES

**A new, automatic teaching machine developed for electronics instruction is being produced by Western Design, a division of U.S. Industries, Goleta, Calif. Called the "Tutor," the machine fully and precisely controls every step in the student's learning process. Functions include instruction, testing, error correction and review.**

THE Tutor simulates complex electronics equipment. Any combination of malfunctions can be presented to a trainee at one time, with the machine providing appropriate responses to every step taken in trouble-shooting operations, just as regular gear would.

The manufacturers describe the teaching machine as basically a combination microfilm-motion picture projector, able to show any one of 10,000 images. It uses standard 35mm film, each frame numbered in sequence and corresponding to a particular setting of the machine.

### IMAGE SELECTION

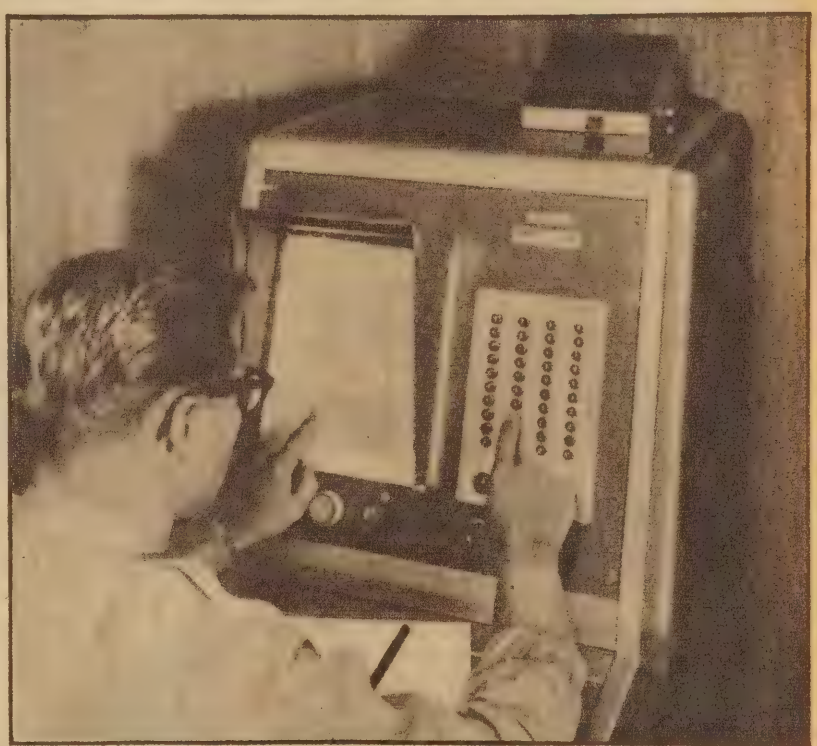
When a certain image is requested by pressing the appropriate buttons on the selector keyboard, a four-digit decimal counter transmits the present position of the projector to the selector keyboard, where it is compared with the desired position.

The resulting "up" or "down" signal generated from the selector keyboard causes the projector motor to move the film forward or backward the required number of frames.

The search speed, or motion of the machine from one frame to any other selected frame, is the standard 24 frames per second, making it possible to include short motion studies to be analysed by the student.

This motion picture can also be run backward or stopped on any given frame for closer study. In normal use, when the machine may jump several frames in search of a chosen answer, the screen remains blank during the search.

To use the Tutor, the trainee is seated before an 8.2in by 11.2in back projection screen and a bank of 40 numbered push-buttons in adding machine arrangement. The screen lights up and a microfilmed image appears, with instructions on how to move to other images by operation of the push-buttons.



***Military student operating "Tutor." Viewing screen displays multiple choice answers to problem and the student makes his choice by pressing the appropriate button. As well as recording the answer, the machine notes the length of time elapsed from the previous answer.***

The next image begins the tutoring sequence by providing the student with a unit of information followed by a multiple choice question. By pushing appropriate buttons on the selector keyboard, the student moves to the image number listed next to his chosen answer.

If he has answered correctly, the machine verifies the answer, gives further instruction and asks another question.

If his answer is wrong, the machine explains where he erred and tests him again, either with a new question or by sending him back to the original question to choose a different answer.

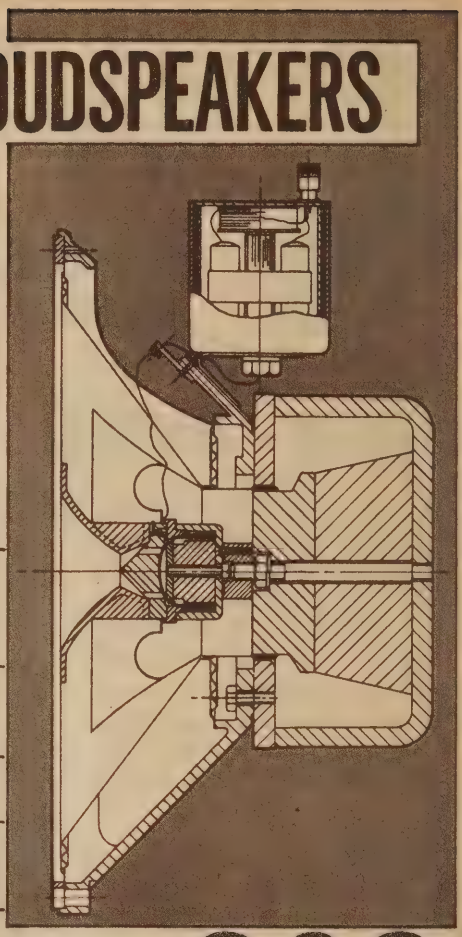
In effect, every student must score 100 per cent on a multiple choice examination to complete a "Tutored" sequence.

The student seated before the machine knows he is to be tested immediately, and consequently learns to pay close attention. Should he choose a wrong answer he is given a more detailed explanation of the material and tested again.

If his answer is hopelessly wrong, the machine is not above giving him a mild warning that he is not paying attention.

Material for the machine is already being prepared by Western Design on such subjects as algebra, trigonometry, electronics and trouble - shooting techniques. (From "Electronics.")

# TRIAXIOM 3 IN 1 LOUDSPEAKERS



**Goodmans Triaxiom series:** These superb 3 in 1 speakers are designed for every pocket. Very wide frequency range, with exceptionally low distortion.

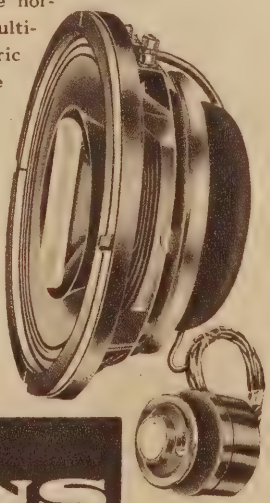
**General Specifications**

*Frequency Range:* 30 — 20,000 c.p.s.
*Impedance:* 15/16 ohms.
*Coil Diameter:* 3" Bass and Mid-range
1" (Aluminium) H.F. Pressure Driver
*Electrical Crossover:* 5,000 c.p.s. twin half section L.C. network 12 db/octave
*H.F. Balance Control:* constant impedance wirewound L-pad, 0-15 db.

| TYPE | SIZE | POWER HANDLING CAPACITY | FUNDAMENTAL RESONANCE | MAGNET WEIGHT | TOTAL FLUX | BAFFLE HOLE | ⅛" BOLT CIRCLE DIAMETER |
|---|---|---|---|---|---|---|---|
| 412 | 12 | 20 watts | 35 | 3½ lbs. | 240,000 | 11" | 11¾" |
| 415 | 15 | 20 watts | 25 | 3½ lbs. | 240,000 | 13" | 14 9/16" |
| 615 | 15 | 25 watts | 25 | 6 lbs. | 308,000 | 13" | 14 9/16" |

# THE UNIQUE TRIAXIETTE/TRIAXIOM 208

This is an 8" unit which has been developed to meet your need for a small unit with design and performance normally found only on larger and more expensive multi-way systems. The 208 comprises three concentric radiators; the bass and mid-range diaphragms are driven by a 3" diameter voice coil and employ mechanical crossover; at 5,000 c/s. a built-in electrical crossover transfers the signal to a pressure driven horn loaded high frequency unit. The magnetic energy for both air gaps is provided by a high efficiency slug magnet with an exclusive concentric gap system developed by Goodmans. Constant impedance continuously variable L-pad automatic control complete with knob and escutcheon is supplied, wired to the loudspeaker for treble output adjustment.



## SPECIFICATIONS

*Frequency Range:* 40 — 20,000 c/s.
*Fundamental Resonance:* 45 c/s.
*Max. Power Handling Capacity:* 10 watts, 20 watts U.S.A.
*Total Flux:* 178,000 Maxwells
*Voice Coil Diameter:* (Bass and Mid-range) 3"
*Voice Coil Diameter:* (H.F.) 1"
*Impedance:* 15 ohms at 400 c/s.
*Baffle Hole Diameter:* 7"
*Mounting:* 4 holes, 9/32" diameter on 7⅝ P.C.D

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# REVIEW—NEW LIGHT AMPLIFIER IS "ULTIMATE"

**Two new electronic developments, each providing a new and different look at the cosmos, have been announced by Dr. J. W. Coltman, manager of the electronics and nuclear physics department at the Westinghouse research laboratories in Pittsburgh, Pennsylvania. Using them, scientists soon will be able to look deep into the far reaches of space for a picture of the Universe never before possible.**

ONE of these advances, a pint-size electronic tube called the Astracon, reaches the near ultimate in man's ability to amplify ordinary light, Dr Coltman said. So sensitive is the tube that it makes visible every elementary particle of light that triggers its ultra-sensitive input.

The other development, a satellite observatory orbiting high above the earth, will house a battery of telescopes equipped with electronic imaging tubes capable of seeing with ultra-violet radiation that never reaches the earth's surface.

In television fashion, these telescopes with transmit down to earth pictures of the Universe which always have been screened from man's eyes by the earth's atmosphere.

In a co-operative program with the Smithsonian Institution, Westinghouse scientists now are developing ultra-violet imaging tubes for the space observatory planned by the National Areonautics and Space Administration, Dr Coltman reported.

"What we will discover with these new tools of research we cannot tell," he said. "We only know that each time man has succeeded in removing the limitations of his own sensing mechanisms — by the telescope, the microscope, the X-ray— he has obtained new information about the world he lives in; information which was not only of interest to the curious scientist, but which eventually had a profound effect upon human affairs."

## RAPID PROGRESS

Dr Coltman described the rapid strides being made in electronically assisting man's ability to see.

"While the eye is indeed a marvellous instrument, it has limitations," Dr Coltman said. "It responds only to a very narrow band of frequencies—that small slice of the whole spectrum of radiation we call visible light; it lets in only a fraction of the light energy available to it; and of the light that does enter, only about one part in 100 sets off that unique chemical reaction which causes vision."

The Astracon tube described by Dr Coltman operates upon a unique amplifying principle discovered at the Westinghouse research laboraties five years ago. The image of an object, so dim as to be invisible to the naked eye, is focused by lenses onto a light-sensitive screen, called a photosurface, at the input end of the tube. The individual particles of light, or photons, arriving from the scene strike the surface and eject electrons from it. Here is where the unique amplifying action takes over.

Each ejected electron is accelerated forward by 2,000-volts and strikes headon into a thin two-layer film, only a few millionths of an inch thick. The front surface of the film is aluminium; on its back surface is deposited a slightly thicker layer of an insulating material.

When a high-speed electron crashes into the film, it penetrates into the insulator and releases four or five additional electrons. These are accelerated into a second film, or dynode, where the electron multiplication is repeated.

By using five such steps, a single electron is multiplied into a swarm of about 3,000. These are given a final 20,000-volt boost and are aimed into a thin layer of fluorescent material at the output end of the tube. Here they release 20,000 or more photons of visible light.

Thus, if the light striking the input photosurface is in the form of a dim, invisible image, the Astracon exactly reproduces that image on its output, only thousands of times brighter.

"The Astracon achieves the ultimate in amplification," Dr Coltman declared, "for now we can see individual electrons, released at the tube's input by the smallest 'piece' of light that exists. Each electron shows up as a separate flash of light. The only way we could increase the Astracon's remarkable sensitivity is to increase the probability that an incident photon will release an electron from the input photosurface.

"This remarkable ability to record photons makes the Astracon useful in many fields of research. In astronomy it will make big telescopes out of little ones and will increase the effective size, or light-gathering ability, of even the largest ones many times over. It will give us a picture of the heavens never before possible.

"In nuclear physics it will, for the first time, allow us to see the tracks of high-energy cosmic rays and other particles which have not been visible before. Until now there has been no practical method for observing these fleeting particles as they flash through solid crystals with a glow too feeble to see.

"And now we have the ability to 'see in the dark.' In our laboratory we have clearly observed objects illuminated only by the light equal to that of a moonless overcast night, when the stars are the only dim source of illumination."

By electronic means, Dr Coltman demonstrated the use of ultra-violet and infrared for extending the range of human vision.

"It is now quite practical to produce infar-red images capable of displaying motion just as in television," he said. "The importance of these infra-red imaging techniques for military purposes is obvious."

## ULTRA-VIOLET ON TV

On a battery of television receivers, the Westinghouse scientists displayed visible images formed only by ultra-violet, or so-called "black light."

"Until recently there was little reason for wanting a seeing system operating in the far ultra-violet because our atmosphere absorbs these frequencies and we do not find them on earth," he explained.

"With the advent of satellites, we now have the means to stick our heads above the earth's atmospheric surface and use the far ultraviolet to take a new look at our surroundings.

"In co-operation with the Smithsonian Institution we are now developing the necessary electronic tubes to take that look and to relay back to earth what they see. It should give us an exciting new picture of the Universe in which we find ourselves."

# "BAILING OUT" IN COMFORT

*As planes fly faster and higher, the problem of "bailing out" increases. Apart from the speed, lack of oxygen and extreme cold may prove fatal unless a pressure suit is worn, and this is not always convenient. A plane at present being designed by Chance Vought Aircraft Inc. in the U.S. plans to solve the problem by detaching the entire pilot's compartment, with its own pressure system, and lowering it on a cluster of three parachutes. The picture shows an artist's impression of the unit in operation.*

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| MULLARD "5-STEREO-7" AMPLIFIER | PF1508 | — | OP412 |
| R. T. & H. 17W STEREO AMPLIFIER | PF1193V | F1-285 or F1-300 | OP297 |
| R. T. & H. 10W STEREO AMPLIFIER | PF1412 or PF1540 | F1-285 or F1-300 | OP301 or OP387 |
| R T. & H. UNIT PLAYMASTER—No. 1 | PF1527 | F6-100 | OPM20 |
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| R. T. & H. 35W P.A. AMPLIFIER | PF1335 | — | OPM12 or OPM13 |
| R. T. & H. TAPE RECORDER No. 3 | PF1460T | F12-100 | OPM1 |
| R. T. & H. 1959 TV RECEIVER | PF1448 | F1-285 or F1-300 | OPS1/3 |
| R. T. & H. WIDE BAND C.R.O. | PF1229 and PF1230 | CF396 | — |
| R. T. & H. NEW STANDARD C.R.O. | PF1552 | F6-100 | — |
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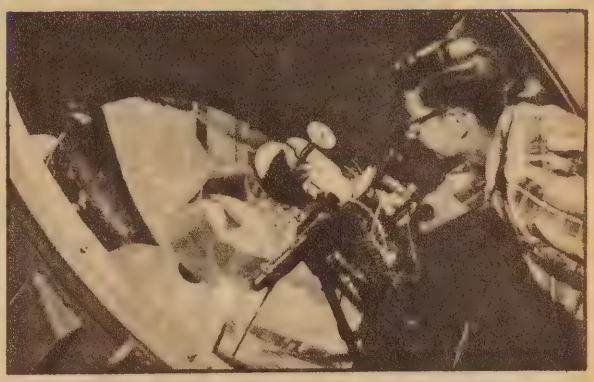
# REVIEW—ELECTRIC POWER FROM THE SUN'S RAYS

**The idea of efficient generation of electric power directly from the sun's rays is an intriguing one since, if successful, it could have a marked influence on our way of life. Many groups are working on the idea, some for specific projects, others in the course of pure research. Here is the story of one group which is developing a solar power plant for space vehicles.**



***The set-up for the direct conversion of the sun's rays into electricity. The converter is shown here at the focal point of the mirror. The mirror itself is 5ft. in diameter and very carefully designed for maximum efficiency.***

☆

THE appearance or disappearance of Seattle's sometimes elusive sun is a matter of great interest these days to a small group of Boeing engineers. These men, members of the physics technology department, are devising ways to convert solar heat to electricity.

Boeing and the General Electric Company are cooperating in joint company-financed development of experimental thermionic converters, which may prove to be the best source of electric power for space vehicles. Progress was reported recently by Henry Oman, Boeing, and George Street, General Electric engineering laboratory.

The thermionic converter is intended primarily to be used in space craft, to power such equipment as navigation and communications instruments and to furnish light for astronauts. Boeing and GE currently are testing pilot models on the roof of a building in the Boeing Developmental Center in Seattle.

The equipment consists principally of a concave mirror, a converter and a radiator. The mirror gathers solar rays, concentrating them on the converter. The resulting heat in the vapour-filled converter releases a stream of electrons; i.e., a flow of electricity.

This is believed to be the first time a thermionic mirror has been constructed and its performance measured, although the theory is not new.

Boeing is providing the experimental mirrors. GE is fabricating the converters. The mirrors, about five feet in diameter, are constructed of lightweight aluminium honeycomb, reinforced with fibreglass.

Their brilliant reflecting surfaces are epoxy resin coated with vacuum-deposited aluminium. Each mirror weighs about five pounds.

The system's thermionic converter, which Oman and Street say will be heated to about 3,000 degress F, comprises a cathode, which is heated, and an anode. The hot cathode discharges electrons across a cesium-vapour gap to the anode. These electrons return to the cathode via an external circuit and thus constitute an electric current flow.

Power is generated only as long as there is a difference between cathode and anode temperatures. For this reason the radiator plays a vital role in maintaining current flow. Fin-type radiators attached to the anodes dissipate waste heat into space.

Solar thermionic converters would be housed inside space ships until the craft were well beyond the earth's atmosphere. They would then be extended outside the vehicle to collect rays of the sun.

How feasible is the thermionic converter? Oman and Street note several advantages.

The thermionic system offers high efficiency. Up to five per cent of the sun's heat can be converted to electricity. This means that two mirrors about 9½ feet in diameter would provide sufficient electricity to light ten 100-watt bulbs.

A smaller unit, to provide 15 watts of power, would weigh only about 2½ pounds. Thermionic generators are compact and inexpensive. They can be produced from readily available materials which already have been proved in the aero-space industry.

Another important consideration, especially on long flights, is that the thermionic generators are unaffected by radiation of the Van Allen type, which is found in outer space. In parts of the Van Allen belt, today's silicon solar cells become useless in only a month or two.

Thermionic converters also contain no moving parts to wear out.

However there are still problems to be overcome. One is keeping the mirrors oriented; that is, facing the sun despite the space craft's course. Scientists have solved this problem in theory, but as yet no one has put a solar oriented system into space.

Another problem is how to connect a number of the generators in series, with each contributing to a common power supply. Says Street, "We're working on it."

Current tests at Boeing solar laboratories involve determining optimum design for the mirrors, radiators and other components. Mirror efficiency in gathering the sun's rays is tested this way:

A pyrheliometer measures the intensity of the sun in calories per square foot. At the same time, solar rays are concentrated by the mirror into a water-cooled container at the focus of the mirror. By comparing the calories collected at the focus with the calories in the sun's rays, engineers can determine the mirror's efficiency. A value of 62 per cent has been obtained in tests.

Another test, to simulate actual space conditions, involves a vacuum set-up to study converter operation in the absence of air.

The goal of these tests, say Oman and Street, is to find the optimum ratio of weight and efficiency in the thermionic converter. Since the supply of sunshine is for practical purposes inexhaustible, light weight is even more important than high efficiency. The converters may be instrumental in helping to extend space-craft range and increase the dependability of instruments millions of miles from earth.

***The efficiency of the mirror is all - important and each one is carefully checked. Shown here is a pyrheliometer being used to measure the sun's intensity. Comparison with the heat from the mirror indicates mirror efficiency.***

☆

# 2 BANK 18 WAY VOLUME SELECTOR GIVES ACCURATE STEREO BALANCE WITHIN ± 0·5DB!

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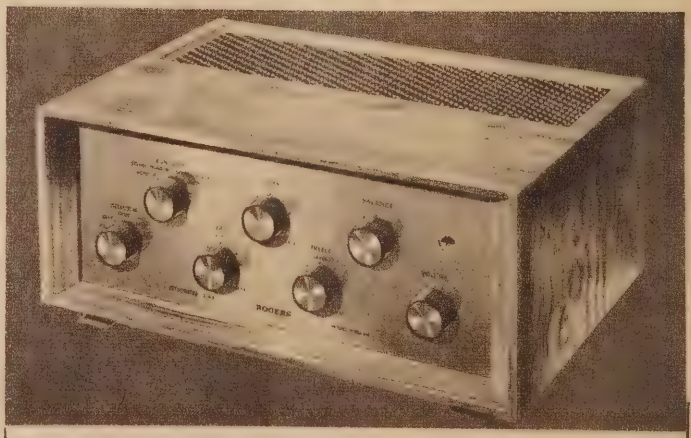

The most critical design feature of any Stereo Amplifier is the Volume Control. The Volume Control fitted to the Model HG 88 is unique in that, instead of the customary potentionmeter, a two-bank, 18-way selector, wired with 5% tolerance resistors, is employed. This form of control ensures that stable accurate stereo balance is maintained at all volume settings, within ± .5DB in this case, and avoids the difficulties associated with carbon potentionmeters when used for stereo. As far as we know this feature is exclusive to the Model HG 88. "Integrated Line."

# ROGERS HG88

*Australian Agent:*

**BRITISH MERCHANDISING PTY. LTD.**

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Please send me, a copy of leaflet describing the new Model HG 88. "Integrated Line."

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# SCIENTIFIC & INDUSTRIAL NEWS

## MEASURING POWER

A NEW system automatically measures the power output of marine engines and engines used to drive industrial plants.

Since it gives the actual power output of the engine and not the torque only, as is the case with most marine engine power output systems currently in use, the new unit can be used in order to produce a precise comparison between engine power output and the fuel consumed.

The meter is said to continuously integrate the data recorded, thereby enabling the efficiency of ships' engines and the fouling of the hull to be kept under continuous observation simply by comparison of the results of successive voyages of the same ship, or by comparing the performance of sister ships of exactly the same design.

The system can be adapted if required to include visual displays or written recordings of the horse power output, revolutions per minute and torque of the engines at the engineers' operating platform.

**Muirhead and Company Limited,** Beckenham, Kent, England.

## MEASURING WIRE TEMPERATURE

A NEW and more accurate device for measuring wire temperature during drawing enables markedly higher drawing speeds to be achieved.

The new temperature measuring device enables maximum drawing speeds for various steel qualities to be very quickly established.

The device can also be used to measure the temperature of the wire during heat treatment, coating processes and "in-line" cleaning.

The unit depends on the pressing of two pulleys made of two different metals and which, therefore, form a thermocouple against the moving wire. This enables a signal to be generated which is transmitted to the measuring unit.

**Addison Electric Co. Ltd.,** Bosworth Road, London, W.10, England.

## WATER CONSERVATION

A NEW method for reducing the evaporation of water from large storage reservoirs is said to yield savings in water of up to 50 per cent.

A special machine has been developed in Australia for processing hexadecanol, anti-evaporation chemical. The machine grinds solid blocks of hexadecanol into a fine powder, which is then blown through a tube out of the back of a moving boat. The powder floats on the water surface to form a thin film, which reduces the evaporation.

The new method is inexpensive, costing little more than a penny to save a thousand gallons of water and a few hundred acres being fully treated within half an hour.

**C.S.I.R.O., Australia.**

## PNEUMATIC AIR VICE

A PNEUMATIC air vice cannot trap the operator's fingers, although it exerts a grip of half a ton.

The operator is safeguarded because the pneumatic movement is limited to one-tenth of an inch. The vice is set to the size of the component, which is then gripped by the pneumatic ram. Maximum gap of the vice's 4¾-inch jaws is 5 inches.

Operated by a foot valve, the vice is said to be invaluable for drilling, milling and other machining where a flow of identical workpieces is being handled, since it facilitates quick loading and unloading while affording a secure and constant pressure grip.

**D. O. Morris,** Coventry, England.

## ULTRASONIC SPOT WELDING

AN ultrasonic spot welding device is said to be capable of welding either similar or dissimilar metals having either the same or different thicknesses.

The device is said to be capable of welding exceptionally thin pieces of metal, materials as thin as 0.00025-inch having been joined as bottom pieces to thicker top pieces in some of the test experiments. The unit is capable of handling top pieces of up to 0.006-inch thickness.

**International Ultrasonics Inc.,** 611 West Main Street, Corry, Pennsylvania, U.S.A.

## STEEL SCALE DETECTION

WHEN steel plates are received from the steel makers they are covered with mill scale, or magnetic iron oxide, a compound which is immune to corrosive attack.

To the user of steel, however, this scale is undesirable since it presents a surface which will not form a good base for paint and also when it is scraped off heavy pitting of the surface occurs.

As a result, the removal of mill scale is an important step in the protection of steel against corrosion. This scale can be removed by means of a process known as shot blasting. However, such removal is only effective if it is complete, and it has proved difficult in the past to produce a precise assessment of the effectiveness of shot blasting on the removal of different thicknesses and hardnesses of scale on the spot where this work is carried out.

A new method which has been developed in Britain overcomes this problem in a very simple manner. It depends on the application of a solution of copper sulphate to the freshly treated steel surface.

The areas of steel surface which are completely free from mill scale become coated with this copper solution, while where any scale occurs it shows up as a dark area against the copper background. Yet the whole copper sulphate application process and the subsequent

## "DUMMY ICE" TESTS AIRCRAFT

***Producing ice on aircraft control surfaces for test purposes presents a number of difficulties. Not only are high altitude flights expensive and time-consuming, but there is no guarantee that icing conditions will be found or that they will produce the effect required. To overcome this Boeing engineers produced imitation ice formations from styrofoam covered with fibreglass. The picture shows one of these fitted to the leading edge of a 707 tail assembly prior to flight tests. With it engineers were able to establish that the 707 has a wide margin of safety even with one third of the tail de-icing equipment out of action.***

# SCOPE

## "SUITS ME"

IT'S SAFE

I chose **Scope** . . . it's the soldering iron that only takes 3.3 volts yet outperforms irons rated up to 150 watts. The National **Scope** transformer is fully protected on the mains side, too — so I solder without any worry with **Scope!**

*Scope is a new concept in soldering irons . . . designed for time saving, accuracy and continuous work. Scope is convenient—with the heat localised at the tip, the iron is ideal for use in a maze of delicate wiring. Scope is fast—is hot in six seconds . . . Scope is light, weighs only 3½ ounces.*

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nspection takes only a few seconds and t requires no more equipment than an mpregnated pad or sponge.

Moreover, this inspection technique ossesses the advantage that it can be nterpreted readily by the man on the ob without special training. It is also ery inexpensive to use.

**Shell Research Limited,** Thornton, Cheshire, England.

## MAKING INTRICATE CASTINGS

A NEW process developed for the manufacture of intricately shaped castings weighing up to 100lb or more yields production of exceptionally accurate shapes and with a finer grain structure and better and more consistent surface finishes.

The new process is said to fill the gap between the recently developed frozen-mercury process and the old solid-mould casting technique.

The process depends on the deposition of successive layers of ceramic around a wax, or wax and plastic casting pattern, or set-up. The original wax, or wax and plastic, or plastic arrangement is dipped into a ceramic slurry primer and is then grained so that a uniform thin coating of ceramic is obtained over the whole unit.

It is the uniformity of this initial coating of ceramic which determines the quality of the final surface finish of the completed casting.

The unit is then covered with a fine granular refractory material which acts as a priming surface for the next coating of ceramic slurry material. The wax is removed from the ceramic shell by means of a heat treatment at 1,800 degrees Fahrenheit prior to the actual casting process.

**Arwood Precision Casting Corporation,** 321 West 44th Street, New York 36, N.Y., U.S.A.

## PLASTIC FITTINGS

THE increasing use of plastic piping and plumbing systems in chemical plants, laboratories, nuclear research stations and also for industrial works and for domestic applications has led to the development of a number of special fittings.

One of the most important requirements of most drainage and plumbing systems is, however, that facilities should be available so that they can be easily inspected at an appropriate number of points throughout the whole system.

A new development which should facilitate such inspection is that of the production of a specially designed series of access chambers for use where polyethylene pipes are used.

The chamber, which is designed so as to facilitate both easy inspection and easy cleaning, consists of an elongated oval-shaped upper chamber which leads into the actual pipe itself.

This upper chamber has a polyethylene lid with a chemically resistant rubber gasket, the lid being attached to the main body of the chamber by means of non-corrodible belts. Where necessary in order to resist pressure a stainless steel packing ring may also be used.

The chambers are being manufactured in both standard polyethylene and in high density polyethylene, which enables moulded pipes and fittings having a greater rigidity and strength and capable of withstanding higher operating pressures to be made.

**Chemical Pipe and Manufacturing Co.,** Kenley, Surrey, England.

## SOLID LUBRICANTS

ONE result of recent research into solid lubricants is the development of a product which is claimed to have a much greater load-bearing capacity than normal lubricants of this type.

The improved lubricant was achieved by the addition of various inorganic sulphides to molybdenum disulphide and to tungsten disulphide and among the most effective of those that have been investigated were the sulphides of antimony, platinum, mercury, silver, titanium and lead.

In tests conducted with a hard steel hemisphere, sliding over a mild steel surface, a film of pure molybdenum disulphide was able to withstand a one-quarter kilogramme load.

When, however, silver sulphide was included in the lubricant, the load-bearing capacity increased to 5.3 kilogrammes. Even better results were obtained when the lubricants were used on relatively hard surfaces such as chromium.

**U.S. General Electric,** Lincoln House, High Holborn, London, W.C.1, England.

## CHEAP FROZEN MILK

RECENT research into processes for producing frozen milk has led to the development of a new technique for producing frozen concentrated milk.

The operation of the process depends on the use of many of the production steps normally utilised already for the sterilisation of concentrated milk.

For example, the high quality milk which forms the raw material is first pasteurised and then homogenised and concentrated by evaporation until it contains 36 per cent total solids.

The finished product is then put into cans, given a further treatment, and then subsequently cooled and frozen.

Tests carried out with the process are said to have shown that it can be readily operated on a commercial scale, and that the milk retains its flavour for at least three and a half months when it is stored at low temperature in the can.

Indeed, samplers found it difficult to distinguish between the processed frozen concentrated milk and concentrated milk which had not undergone the freezing and storage.

**University of Wisconsin,** College of Agriculture, Madison 6, Wisconsin, U.S.A.

## STRONGER CERAMIC

A NEW ceramic material can withstand extremely high temperatures, and is stronger and more resistant to oxidation, or corrosion, than ordinary graphite.

The material, which has a flexural strength in the neighbourhood of 25,000 lb per square inch as compared with 1,000 to 8,000 lb per square inch for ordinary graphite, is a special hard dense silvery-grey graphite compound known as pyrolitic graphite.

The material, which is slightly heavier than ordinary graphite, has a tensile strength of approximately 40,000 lb per square inch at temperatures above 5,000 degrees Fahrenheit. This compares with a tensile strength of less than 1,000 lb per square inch for tungsten at the same temperature, yet tungsten is the best high strength material now known for industrial use.

Dr William H. Smith, **International General Electric Co.,** Research Laboratory, Schenectady 5, New York, U.S.A.

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MODEL M7D SPECIFICATIONS

*Channel Separation:* More than 20 db at 1000 cps. *Frequency Response:* 20 to 15,000 cps. Output Voltage: 5 mv per channel at 1000 cps. Compliance: Vertical, Lateral 3.5 x $10^{-6}$ cms. per dyne. Mounting: Standard ½" and 7/16" centres. Price: £19.0.0 (less cash discount).

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Full 12" Turn-table, lathe turned and non-ferrous. Precision ground shafts running in new nylon graphite bearings.

The dynamically balanced, synchronous motor is virtually vibrationless. Ideal for stereo. Price: £29.10.0 (less cash discount).

MASTER SOUND

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☆

*The modulator described in this article is housed in the centre section of the cabinet. The meter in the centre is the level indicator, while there are two input jacks, with volume controls, in the lower left hand corner. One is for the microphone and one for a key in the tone oscillator circuit.*

☆

If miniaturisation is desired, 12AU7s and 6AU6s may be substituted with only minor circuit alterations.

There are three main differences between this modulator and the well-known 2JU modulator.

First, the 807s are operated in Class AB1, instead of AB2. This eliminates the need for a driver transformer and fixed battery bias.

Secondly, a 300 to 3,000 cps. filter is included to limit the bandwidth of the audio output to the speech frequencies, improving the "punch" of the signal and providing an extra safeguard against "splatter" due to exaggerated sidebands.

Thirdly, a tone oscillator circuit is included, keyed in its cathode, to enable modulated Morse code signals to be transmitted.

## MODULATED CW

While modulated CW is prohibited on the lower frequency amateur bands, it may be used on 144 Mc. The tone oscillator is useful for providing a steady audio signal to allow receiving stations to "peak" their beams on a transmitting station.

Tone is also used during two-metre "fox hunts" to give the "hounds" a clue to the whereabouts of the "fox"; and while we do not envisage lugging this modulator out to the car, the tone oscillator circuit may be adapted for smaller mobile rigs.

To match the transmitter and power supply, the modulator is built on a standard 17in x 10in x 3in chassis. The front panel measures 18in x 12in and overlaps the chassis by half an inch at each side and on the bottom.

# 75 Watt 144 Mc Transmitter

**The modulator described here is capable of producing 50 watts of audio power, and the various tappings on the secondary of the modulation transformer allow it to be matched to various transmitters. It was built for use with the high-power two-metre transmitter described last month, and completes that project. Constructional details for the three-deck cabinet are also given in this article.**

***By Vol Molesworth M.A. (VK2VO)***

## Part Two

THE high-power two-metre transmitter described last month employed a QQE06/40 twin tetrode as its final RF amplifier and is capable of delivering up to 100 watts of power to the aerial circuit. Even with full negative bias applied, it comfortably produces 75 watts.

To modulate the final fully, between 37½ and 50 watts of audio power is required. A pair of 807 beam power pentodes, operating in push-pull, with about 600 volts on their plates, seemed the simplest solution.

The modulator is built along much the same lines as the famous 2JU 60-watt modulator designed by the late John Moyle. Originally published in this magazine in May, 1947, the 2JU modulator has been built and used by many amateur radio operators over the years —including the author of this article, who has such a modulator in service at present in his 40-metre rig.

No apologies are made for following the general design of the 2JU modulator. Its merits are yet another tribute to the late John Moyle's technical ability and his practical understanding of the needs of radio amateurs.

No apologies are offered, either, for the use of 807s and other older-style valves, such as 6SN7s and 6SJ7s. We could have built the modulator with modern miniature valves, but the GT-type tubes were on hand; they do a good job; and we were not out to save space.

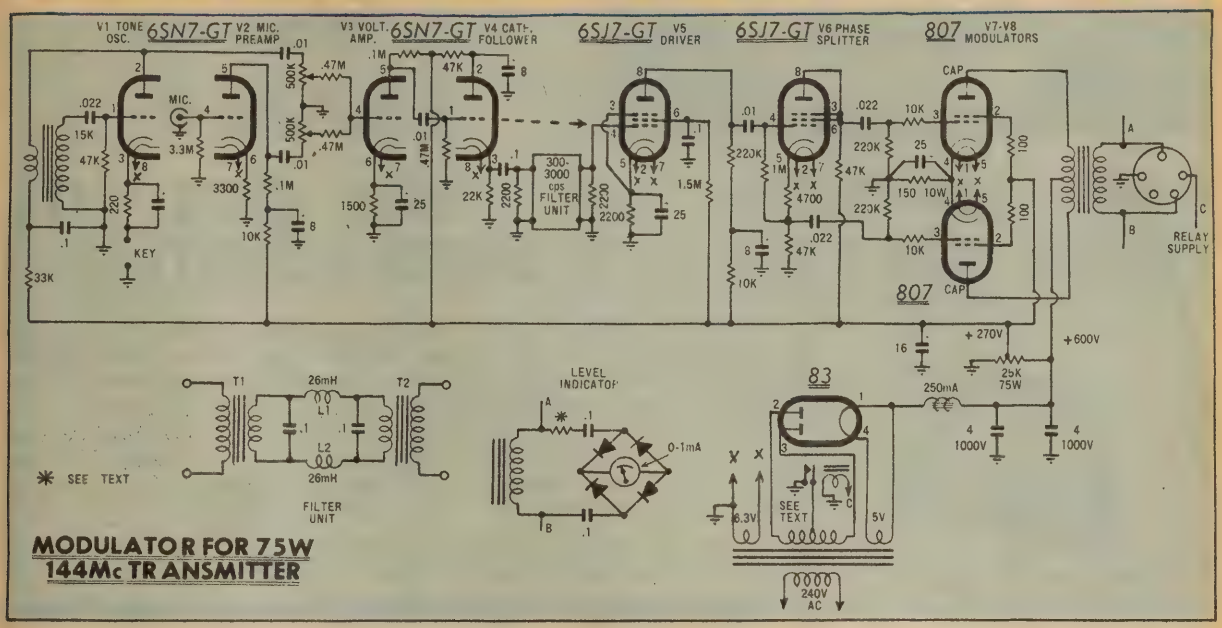
The completed unit slides into the middle section of the cabinet and is connected to the transmitter by a cable at the rear.

The modulator has its own power supply, built on the same chassis. The 240 volts AC lead plugs into a standard 3-pin socket already provided on the rear of the transmitter power supply chassis.

As with the other units in the cabinet the front panel of the modulator is pointed with quick-drying grey enamel paint.

Looking at the back of the unit, the power supply section is seen running along the rear of the chassis, comprising (from right to left), the 475 volts per side transformer, 250 mA choke, 8

# DESIGN FEATURES TONE OSC. AND SPEECH FILTER




**MODULATOR FOR 75W 144Mc TRANSMITTER**

***The latter half of the modulator is a straightforward set-up using voltage amplifier, phase splitter and push pull 807s. In addition to the normal mic. preamplifier in the front end there is a tone oscillator with keying facilities and a cathode follower feeding a speech band-pass filter.***

mercury vapor rectifier valve, and 4 mfd 1,000 V oil-filled capacitors. A second 4 mfd 1,000 V capacitor is mounted underneath the chassis immediately below this one, and the two are connected in parallel to provide a total filter capacitance of 8 mfd. (The DC voltage rating, of course, remains at 1,000 V.)

Running across the front of the chassis close to the front panel, from right to left, are the valves, starting with the 6SN7 tone oscillator and microphone preamplifier, 6SN7 voltage amplifier and cathode follower, then the speech filter unit, 6SJ7 driver, 6SJ7 phase splitter, and the two 807 modulator valves, with their top caps.

## UNDERCHASSIS VIEW

The modulation transformer is mounted immediately behind the 807s.

The general layout can be seen in the photographs.

Looking at the front panel, the level meter is seen at the centre. In the lower left-hand corner are the two input jacks and their gain controls, one for a crystal microphone, the other for a Morse key. At the right-hand side is the main ON-OFF switch and a fuseholder.

Should it be desired to key the transmitter for unmodulated CW, the mains switch is simply flipped off and the 500-volt supply to the final passes through the secondary of the modulation transformer with no audio added to it. (The transmitter must now be independently keyed, of course.)

Looking at the underneath of the chassis, the first thing to be noticed is a long tagboard running practically the whole width of the chassis. This is actually made up of two lengths of tagboard, one with 23 lugs on each side, the other with nine lugs per side. These are mounted on 2½in bolts just behind the line of valves.

The majority of the resistors and capacitors associated with the valves are soldered across these tagboards, and connections are then made to the appropriate valve pins by means of short lengths of 18-gauge tinned copper wire.

The first seven lugs on each side are used to terminate the various tappings on the primary and secondary windings of the modulation transformer.

These boards are wired up separately and are the last components to be placed in the chassis. To enable you to wire them, drawings are provided in this article.

A tagstrip will be seen in the top right-hand corner of the chassis. This has only seven lugs, and facilitates some of the wiring to the 807 ceramic 5-pin sockets. Beside it is a vertically mounted 150 ohm wirewound resistor, which is common to both 807 cathodes, with a 25 mfd, 40V electrolytic capacitor wired across it.

At the far left of the long tagboards, mounted on stand-offs from the left-

## PARTS LIST

### TRANSMITTER

1 Chassis 17in x 10in x 3in.
1 Front panel 18in x 12in.
1 Modulation transformer with multiple taps (see text).
1 Power transformer, 475/0/475 at 250 mA, 6.3 volts, 5 volts.
1 250 mA power choke.
1 Speaker transformer, 15,000 ohms to 3 ohms.
1 Bandpass filter unit (see text).
1 0-1 mA meter.
1 Meter rectifier to suit.
2 Phone jacks.
4 Octal sockets.
1 5-pin socket.
2 5-pin steatite RSS5 807 sockets.

### RESISTORS

1 3.3M ½W
1 1.5M 1W
1 1M ½W
3 .47M ½W
3 .22M 1W
2 100K 1W
4 47K 1W
1 25K 75W WW
1 22K ½W
4 10K ½W
1 4.7K ½W
1 3.3K ½W
2 2.7K ½W
1 2.2K ½W
1 1.5K ½W
1 250-ohm ½W
1 150-ohm 10W WW
2 100-ohm ½W
2 500K potentiometers

### CAPACITORS

4 25 mfd. 40PV electro
1 16 mfd. 600PV electro
3 8 mfd. 600PV electro
2 4 mfd. 1000V oil filled
4 .1 mfd. 600V paper
1 .1 mfd. 200V paper
3 .022 mfd. 600V paper
4 .01 mfd. 600V paper or mica

### VALVES

2-6SN7, 2-6SJ7, 2-807, 1-83.

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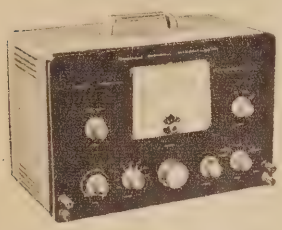

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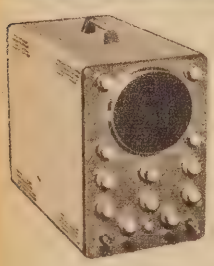
### HARMONIC DISTORTION METER KIT HD-1

Used with an audio generator such as the Heathkit model AG-9A, this quality instrument will accurately measure harmonic distortion at any or all frequencies between 20 and 20,000 cps.
The distortion characteristics of audio amplifiers and components are quickly determined after the fundamental frequency is eliminated by the fundamental-suppression circuit in the analyser. The remaining signals include all frequencies in the audio range excluding hum, noise and harmonics from the generator, from the equipment under test and from the instrument itself. The indicated remains represent distortion which is read directly on the panel meter in ranges of 0-1, 3, 10, 30 and 100% full scale. Full scale voltage ranges of 0-1, 3, 10 and 30 volts are provided for the initial reference settings. Signal-to-noise ratio measurements are also possible through the use of a separate meter scale calibrated in db.
Wgt. 13lb.
Size 13in x 8½in x 7in.

*Low Cost, Reliable R.F. Gen.*

### HEATHKIT R.F. SIG. GENERATOR KIT SG-8

Provides extended frequency coverage in five bands from 160 Kc. to 110 Mc. on fundamentals and on up to 220 Mc. on calibrated harmonics of the fundamental freq. Prewound and preadjusted coils make calibration unnecessary for service applications. Allows alignment of R.F., I.F. and tuned circuits of all kinds and is useful as a signal source for signal tracing in faulty receiver circuits. Provides stable, modulated or unmodulated output of at least 100,000 microvolts. Internal modulation is at a freq. of 400 c.p.s. and can be used separately with 2-3 volts of A.F. output available for audio tests. The unit can be modulated at other freq. if desired.
Wgt. 8lb. Size 9½in x 6½in x 5in.



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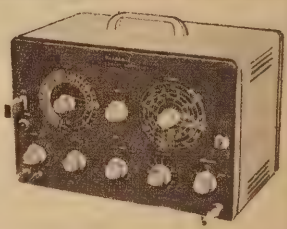
### HEATHKIT "EXTRA DUTY" 5in. OSCILLOSCOPE KIT 0-12

The unique Heath patented sweep circuit in this unusual scope offers five times the normal sweep found in other scopes.
Wide band amplifiers make the 0-12 ideal for colour TV servicing, specialised and general circuit investigation. Excellent linearity and lock-in characteristics—view a single wave even at upper frequency limits. Other features include push-pull vertical, horizontal output amplifiers, peak-to-peak calibrating source. Input to vertical amplifier has 3-step freq. compensated input attenuator. 11-tube circuit includes 5UP1 cathode ray tube and provision for Z-axis input for intensity modulation of beam. Extremely short retrace time, efficient blanking action provide excellent display of essential TV waveforms. Positive trace position controls prevent bounce or overshoot.
Size: 14½in x 8⅝in x 16in. Wgt. 22lb.

*A TV Laboratory in itself*

### HEATHKIT TV ALIGN. GENERATOR KIT TS-4A



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This handy kit checks capacitors for "open" or "short" right in the circuit. Detects open capacitors from about 50 mmf, not shunted by an excessive low resistance value. Checks shorted capacitors up to 20 mfd (not shunted by less than 10 ohms). (Does not detect leakage nor check electrolytic condensers.) Checks all bypass, blocking and coupling capacitors of the paper, mica and ceramic types. Uses an electron beam "eye" tube for quick indication.
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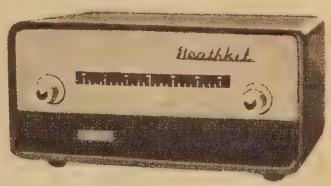


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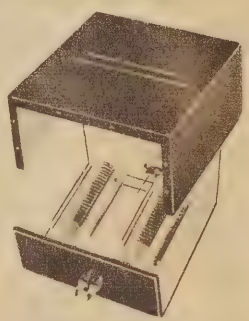
Size: 11⅞in x 5¼in x 7in.



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The so-called "permanent" needles sold with modern record reproduction equipment will wear out, contrary to the usual belief. These needles actually have an effective playing life of approximately 40 playing hours . . . then the smooth radius starts to wear, the needle sinks lower in the record groove, the delicate sound track is chiselled away.

*This worn needle rides lower in the groove than a good needle and planes off sound with every playing.*

**The B.M.B. range of sapphire styli includes over 30 different types—most available with diamond point, and interchangeable with other brands.**

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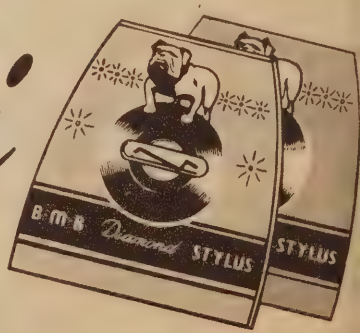


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MSA1097

and side of the chassis, is the 15,000-hm to 3 ohm speaker transformer which is used in the tone oscillator circuit.

The secondary is connected in the plate, and the primary in the grid. This is a standard Hartley oscillator, using inductive feedback between the plate output and grid input of one half of the first 6SN7. The frequency of the audio is determined largely by the time constant of the R-C network in the grid circuit.

We used a combination of .02 mfd and 50,000 ohms to produce a tone with a frequency of 1,000 cps. Increasing the value of the capacitor will lower the frequency of the tone, while reducing its value will increase the frequency of the tone.

The grid coupling capacitor is wired across the very end of the tagboard, and may easily be removed if you have to experiment with various values of capacitance to obtain the tone desired.

To the side of the speaker transformer is seen a small tagstrip, mounted on stand-offs, which is used to terminate the heavy duty filament leads to the 83 rectifier, and the centretap.

In the bottom right-hand corner of the chassis is seen the second oil-filled filter capacitor, mentioned earlier.

## VOLTAGE DIVIDER

Beside it, running parallel with the long tagboard, a 25,000-ohm, 75-watt voltage divider is bolted to the floor of the chassis. The left-hand end is earthed, the right-hand end being connected to the "hot" terminal of the 4 mfd 1,000V capacitor.

The 270-volt tap for the early stages of the modulator occurs about the middle of the voltage divider, not far from the B-plus point on the tagboard (lug 14).

The screen supply for the 807's is also taken from this point, by-passed with a 16mfd 600V electrolytic capacitor.

The ceramic 4-pin socket for the rectifier lies behind this voltage divider, the pin to its directly-heated cathode handy to the "hot" terminal of the filter capacitor.

To the right of the rectifier socket, a small tagstrip is mounted on the rear of the chassis. This is used to terminate the 240-volt AC leads to the transformer, and the ON/OFF switch and fuse-holder at the front of the chassis, and also the unused 220 and 260 volt taps in the primary winding of the power transformer.

On the back of the chassis is a 5-pin socket. This brings in the unmodulated 500-volt supply and a relay supply voltage, and takes out the modulated high tension for the final on the chassis above.

The relay, which opens and closes the earth connection to the centretap of the secondary of the power transformer, is mounted to the left-hand side of the chassis, behind the speaker transformer. This is normally open-circuit.

At the front of the chassis can be seen the two potentiometers and the two phone jacks for the two input circuits.

Looking at the circuit of the modulator, it will be seen that one of these input jacks connects a microphone to the grid of a triode.

Since it was desired to use a crystal microphone, this stage has a high value of grid resistance (3 megohms), which is wired straight across the input jack. The unby-passed 3,000 ohm cathode resistor is wired between pin 6 of the socket and earth.

The second half of the twin triode valve is used for the microphone pre-amplifier stage, to keep the grid as far away as possible from the heater pins to avoid "hum" pickup from the 6.3 volts AC.

The plate is decoupled from the common high tension line by a 10,000 ohm resistor and an 8 mfd 600V electrolytic capacitor.

Output from this stage is fed through a .01 mfd capacitor to the top of one of the ½ megohm potentiometers. This capacitor is wired straight from pin 5 of the socket to the pot. The load resistor (100K) and decoupling network are mounted on the 9-lug tagboard.

The other half of this valve is the tone oscillator. The secondary of the transformer (3 ohms) is wired between the plate (pin 2) and B-plus, by-passed with a .1 mfd 400V tubular capacitor.

The 250 ohm cathode resistor and its 25 mfd 40V electrolytic by-pass are twisted together by their pigtails in parallel and wired from pin 3 to the unearthed side of the key jack, which is normally open circuit.

When the key is depressed, current flows through the tube, introducing feedback through the speaker windings to the grid. The resultant tone is fed through a .01 mica capacitor (located on the tagboard) to the other ½-megohm potentiometer.

## SIMPLE MIXER

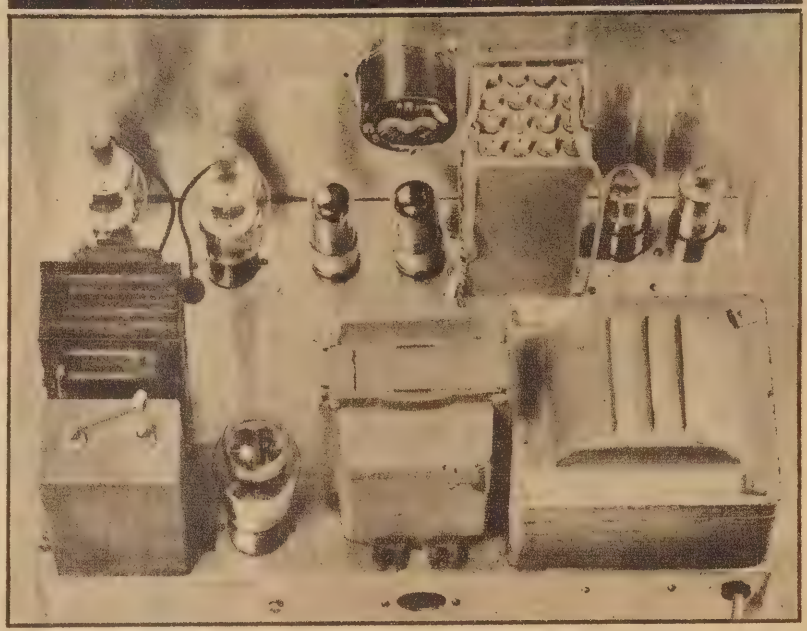
The moving arms of each pot. are connected to the input grid of the next stage through ½-megohm isolating resistors, to prevent interaction of the two controls.

The next stage is a voltage amplifier. Half of the second 6SN7 twin triode is used for this function. Its 100K. plate load is located on the tagboard; the 1500-ohm cathode resistor and 25 mfd 40V electrolytic by-pass are wired from pin 6 to ground.

The other half of this valve is a cathode follower, which changes the high impedance output from the voltage amplifier to low impedance input for the speech filter unit. This is a commercial unit, manufactured some years ago, which we happened to have available. It has a number of connections, enabling various bandwidths to be selected.

Newer versions of this speech filter

## MODULATOR CHASSIS LAYOUT



*The main power supply components are shown at the rear of the chassis, the power transformer on the right, then the filter choke, the 83 rectifier, and one of the two 4 mfd oil filled capacitors. From right to left across the front of the chassis, the mic amplifier/tone oscillator, voltage amplifier/-cathode follower, speech filter unit, driver, phase splitter, and output stage.*

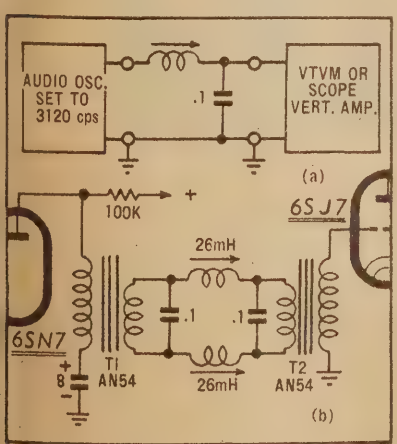
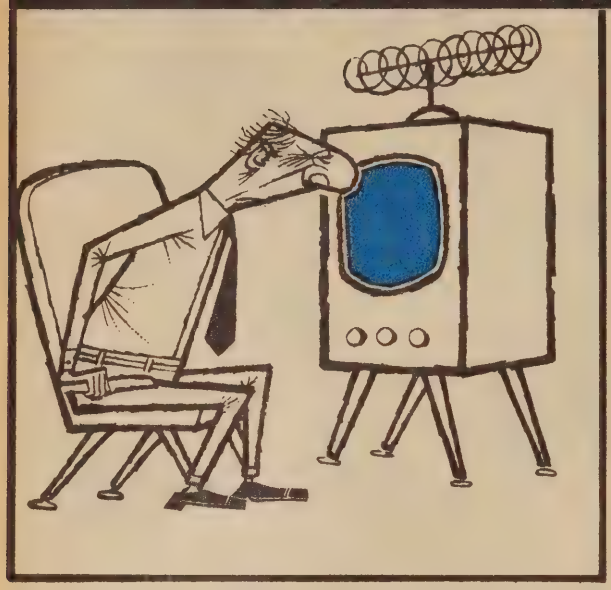



*Fig. 1. (a) Simple set-up to adjust the inductance of L1 and L2. At (b) is the alternative method of connecting the filter when transformers replace cathode follower.*

# Guess Who?



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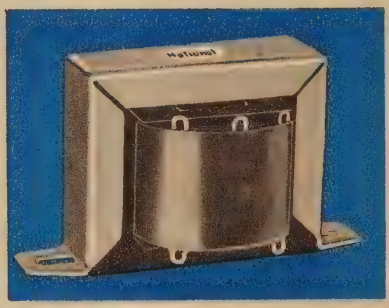

**Type BT7.5/11,** with a 240V primary, which does not draw current from the mains transformer and prevents overloading.
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nit are available, and you can adjust he circuitry here to suit the unit you btain.

Alternatively, if you wish to wire up speech filter network for yourself, here s how it is done.

First of all, it is necessary to attenuate he frequencies below 300 cps, and this an be accomplished with ease by using ow values of coupling capacitors or from 001 to .005 mfd and small cathode by-ass capacitors in the early stages of he modulator.

The high frequencies, above 3,000 cps, must also be attenuated, and something a little more elaborate is required to do his job.

A pi filter as shown in the circuit can be used. The 26 millihenry coils can be toroid wound inductors, or can be a pair of slug-tuned TV width coils, which are commercially available. The inductances can be adjusted to the specified value of 26 mH by using an impedance bridge or "Q" meter.

If such an instrument is not available, he slug setting can be found by resonating the coil with a .1 capacitor at 3120 cps. The circuit shown in Fig. 1 (a) can be used to adjust the slug. The oscilloscope or VTVM will be read for maximum for the series-resonant condition.

## COIL MOUNTING

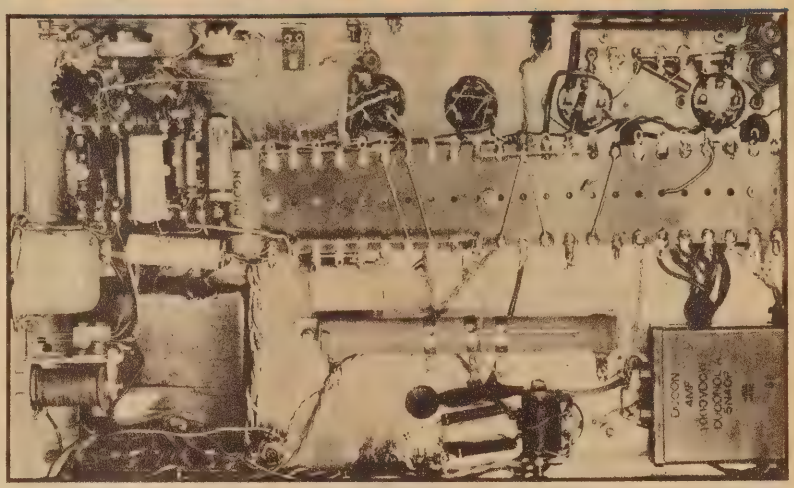
The two coils L1 and L2 should be mounted so that there is minimum mutual coupling between the two windings. If toroidal coils are used, they may be mounted on the same support, because a toroid has no external field.

The characteristic impedance of this filter is 500 ohms, so the transformers T1 and T2 are necessary to match from one valve to the next. These can be type AN54 transformers designed for single sideband work, which have an impedance ratio of 20,000 ohms to 600 ohms. The cathode follower stage would be eliminated and the filter wired as in Fig. 1 (b).

If a speech filter is not considered necessary, the output from the voltage amplifier can be taken to the grid of the driver, as indicated by the heavy dotted line in the circuit diagram. (The 2,500 ohm resistor in the grid of the driver will now be omitted).

Frequency response of the amplifier in this case will be solely determined by the choice of coupling capacitors, grid resistors and cathode by-pass capacitors.

# UNDERCHASSIS LAYOUT DETAILS



*At top left are the two 6SN7s, in the centre the two 6SJ7s, and at right the two 807s. On the left hand end of the chassis is the tone oscillator transformer and beneath it the HT relay in the power transformer centre tap.*

The two 6SJ7s are conventionally wired as driver and phase-splitting stages. The driver is decoupled from the common high tension line with a 10 K resistor and 8 mfd 600 V electrolytic. These components, together with the load resistor, screen resistor and by-pass, and cathode resistor and by-pass, are all mounted on the long tagboard.

The phase-splitter is triode-connected, its plate, suppressor and screen tied together at the socket. Once again, the components associated with this stage are all located on the long tagboard.

The two .02 mfd capacitors from the phase splitter's plate and cathode, together with their .25 megohm grid resistors, are also mounted on the long tagboard; indeed, they are the first components on this board after the seven lugs which are used to terminate the tappings on the modulation transformer.

A 10,000 ohm ½-watt resistor is placed in series with each 807 grid resistor. These "stoppers" serve to suppress parasitic oscillation in the modulators. For the same reason, 100 ohm "stoppers" are placed in series with the screen supply.

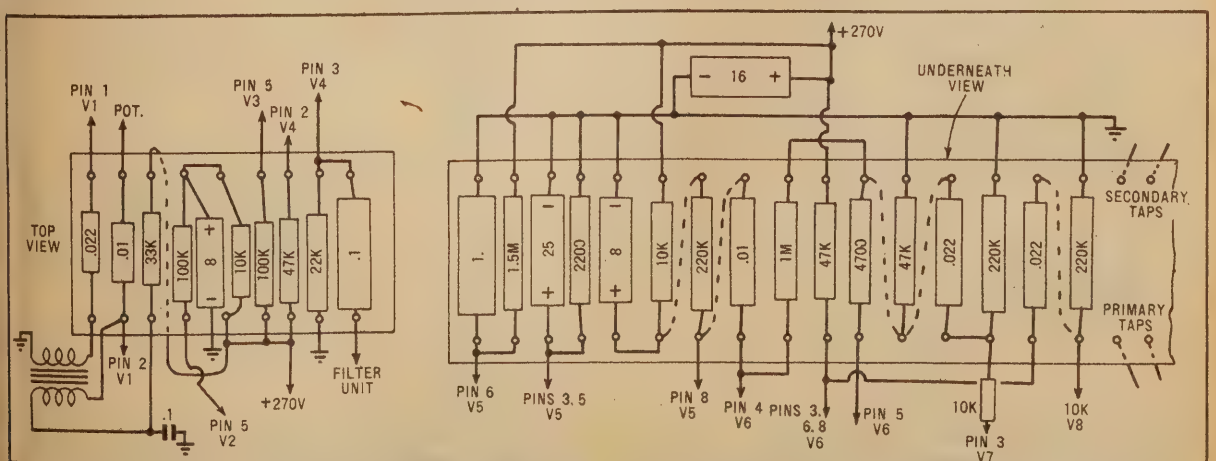
We found it convenient to wire one of these grid stoppers from the 10th lug on the board straight to the grid pin on the left-hand 807 socket. The other stopper is connected between the grid pin on the right-hand socket and the third lug on the 7-lug strip fixed to the front panel above the 807 sockets.

## SCREEN STOPPERS

Both screen stoppers are wired from this strip to the sockets. They are linked together on lugs 6 and 7 of the 7-lug strip, and connected to the 270-volt line at lug 14 on the long tagboard. At this point also is connected the 16 mfd 600 V electrolytic screen filter capacitor.

In the 2JU modulator the high-tension applied to the 807 plates was not filtered. This method was used to obtain as high a plate voltage as possible from the 385 volts per side transformer used.

We decided to increase the size of the power transformer and use filtering here.




*A detailed layout of the two main resistor panels. The smaller panel (left) is shown right way up (i.e., as in the photograph). The larger one is shown turned over, or in the position it will occupy while being wired.*

# Mullard AW59-90

## 23" TELEVISION TUBE

### TELEVISION TUBE AW59-90*

**Direct viewing television tube with 23-in. diagonal, rectangular, metal-backed, grey glass screen. This tube has electrostatic focusing and 110° magnetic deflection. An external ion trap magnet is not required.**

### HEATER

**Suitable for series or parallel operation.**

| | | |
|---|---|---|
| Vh | 6.3 | V |
| Ih | 300 | mA |

### EXTERNAL CONDUCTIVE COATING

**This tube has an external conductive coating which must be earthed, and the capacitance of this to the final anode is used to provide smoothing for the e.h.t. supply.**

### CAPACITANCES

| | | |
|---|---|---|
| Cg-all | 6.0 | pF |
| Ck-all | 4.0 | pF |
| Ca2+a4—M | 1800 | pF |

### SCREEN

Metal-backed

| | | |
|---|---|---|
| Fluorescent colour | White | |
| Light transmission (approx.) | 75 | % |

### FOCUSING

Electrostatic.

### DEFLECTION

Double magnetic.

### RASTER CENTRING

**See note under this heading in "General operational recommendations — cathode ray tubes".**

| | | |
|---|---|---|
| Centring magnet field intensity | 0 to 10 | G |
| Maximum distance of centre of centring field from reference line | 57 | mm |

**Adjustment of the centring magnet should not be such that a general reduction in brightness or shading of the raster occurs.**

### TYPICAL OPERATING CONDITIONS (Cathode Mod.)

| | | | |
|---|---|---|---|
| Va2+a4 | 16 | 16 | kV |
| Va3 (focus electrode) | 0 to 400 | 0 to 400 | V |
| Va1 | 300 | 400 | V |
| Vg for visual extinction of focused raster | -30 to-72 | -38 to-94 | V |
| Vk for visual extinction of focused raster | 28 to 60 | 36 to 78 | V |

**All voltages are measured with respect to grid.**

### MOUNTING POSITION

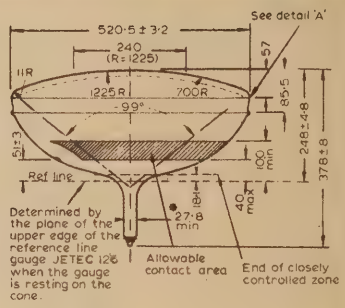
Any

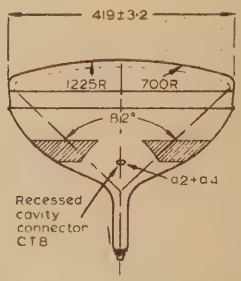
**The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 45 mm which is centred upon the perpendicular from the centre of the face. This tube is fitted with a pin protector in order to avoid damage to the glass base due to bending of the base pins whilst handling the tube.**

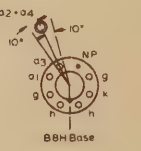
**It is advisable to keep this pin protector on the base until it can be replaced by the socket after installation of the tube in an equipment.**

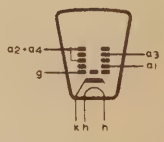
Mullard

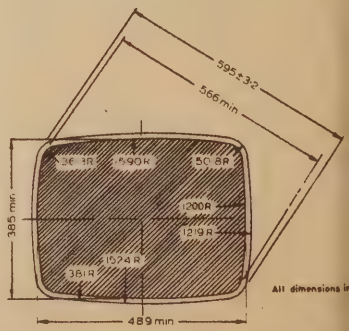
* ***Preferred type for Australian television receivers***

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Choke input filtering is used to protect the 83 mercury vapour rectifier and, at the same time, to obtain better regulation.

The plate voltage needed for the 807s is approximately 600, and, with a choke input filter, the power transformer will need to deliver around 660 volts to the 83 rectifier. We happened to have on hand a unit rated at about 500 volts, 250 mA, but which, at the quiescent current of 85 mA, delivers near enough to the required value.

Alternatively, a 5R4GY (or similar) rectifier could be used with capacitor input filtering. Although regulation will suffer this is not likely to be a serious objection under "speech only" conditions.

The 15,000-ohm to 3-ohm speaker transformer used in the tone oscillator circuit is an MSP type XA3.

## LEVEL INDICATOR

Most of the modulators we have built —including the 2JU—have employed 250 milliamp meters in series with the centre tap of the primary of the modulation transformer, to provide a reading of standing and peak current drawn by the modulator valves.

Just to be different, we wired an AC voltmeter into this modulator to monitor audio level at the secondary of the modulation transformer.

Selecting a suitable multiplier may call for some compromise. At 50 watts the signal voltage will be around 400, suggesting a .39M, at least for a steady tone. For speech, due to meter inertia, it may be necessary to select a somewhat smaller value on an experimental basis.

Coming now to the modulation transformer, the one we used has multiple taps on both windings. (The nearest commercial unit is the A & R MT 15, although other types could be used).

Our transformer is rated at 75 watts, and is tapped on the primary side for push-pull impedances of 3,800, 6,600 and 8,000 ohms per plate, with a common centre tap. These taps are terminated on the first seven lugs of the long tagboard, at the rear.

The secondary is tapped from common to 3,500, 4,500, 5,500, 6,500, 7,500 and 10,000 ohms impedance. These taps are terminated on the first seven lugs on the front of the long tagboard.

The colour coding of our transformer is—primary: centretap (red), 3,800 (black), 6,600 (yellow) and 8,000 (green); secondary: common (red with blue dash), 3,500 (red with blue dot), 4,500 (yellow), 5,500 (red), 6,500 (black), 7,500 (orange) and 10,000 (green).

The color coding of your transformer may be different, but it is a wise move to identify the taps and terminate them in ascending order on the long tagboard, marking the values with a sharp scriber. (You may want to experiment with other impedance matchings later).

If the modulator is being built for general use, these tappings could be terminated on a pair of rotary switches, suitably marked on the front panel.

The final amplifier in the transmitter, using 500 volts DC supply, has a DC input of 75 watts when it is loaded to 150 milliamps. The resistance presented by the QQE06/40 to the modulator is therefore 500 divided by 150/1,000, which equals 3,333 ohms.

The tappings used, therefore, are 6,500 a side for the primary and 3,500 for the secondary.

The first units to be mounted on the chassis are the heavy transformers and chokes. Next the valve sockets are mounted, and the heater and earth wiring put in. One side of each heater is earthed at the socket. We made a common earth line by tightly twisting two lengths of 18 gauge tinned copper wire.

The earth "bus" is mounted in a T-shape, the horizontal arm of the T running across the chassis below the valve sockets, the vertical arm coming down to the main earth point at the rear of the chassis.

## HT SYSTEM

Next the high-tension system is wired in, using heavy insulated cable. The leads to the 807 topcaps are taken through 3/8in holes drilled beneath the 6,600 taps on the long tagboard. These holes should be insulated with rubber grommets.

The resistors and capacitors not mounted on the tagstrips should be now soldered in at the various valve socket pins.

At this stage, the front panel may be attached to the chassis, and the input jacks, pots., switch and fuseholder screwed in. Wiring to these components and from the small tagstrip to the 807 sockets is completed before the long tagboards are mounted across the chassis.

These tagboards should be wired up on the bench from the wiring guides provided. The components are mounted on one side of the board, the cross-connections on the other.

In the photograph, one tagboard is mounted with the components uppermost, the other with the components beneath the board and the cross-connections shown. (For easy servicing, however, all components should be mounted above the board.)

To mount the tagboards, drill 1/8-in holes through the centre at about 3in intervals. Corresponding holes are then drilled in the chassis. Bolts 1/8-in in diameter and 2½ inches long are pushed through the chassis holes, and nuts wound down on them over spring washers.

A second nut is wound down each bolt for about a quarter of an inch. The tagboards are then pressed over the bolts, and a final locking nut tightened over each bolt.

To test the modulator, a wirewound resistor of 3,500 ohms with a rated dissipation of 75 watts is used. We wired ours to a 5-pin plug and plugged it into the socket at the rear of the chassis. This places a dummy load across the secondary of the modulation transformer.

A high resistance AC voltmeter is connected across this resistor. Short out the Morse key jack (thereby switching on the tone oscillator) and turn up the gain control of the oscillator.

The reading on the voltmeter will slowly rise to a maximum. The power output in watts is calculated by multi-

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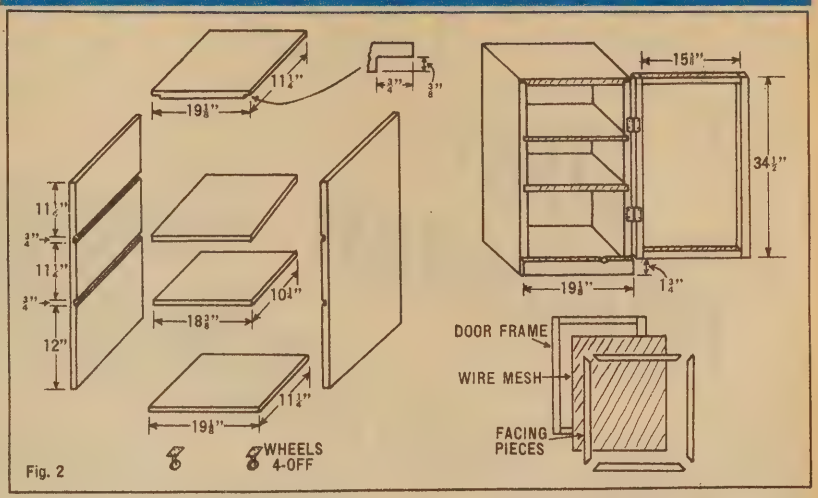

Fig. 2

***On the left is an exploded view of the cabinet, showing all essential dimensions. On the right is an assembly diagram, showing how the pieces are fitted together.***


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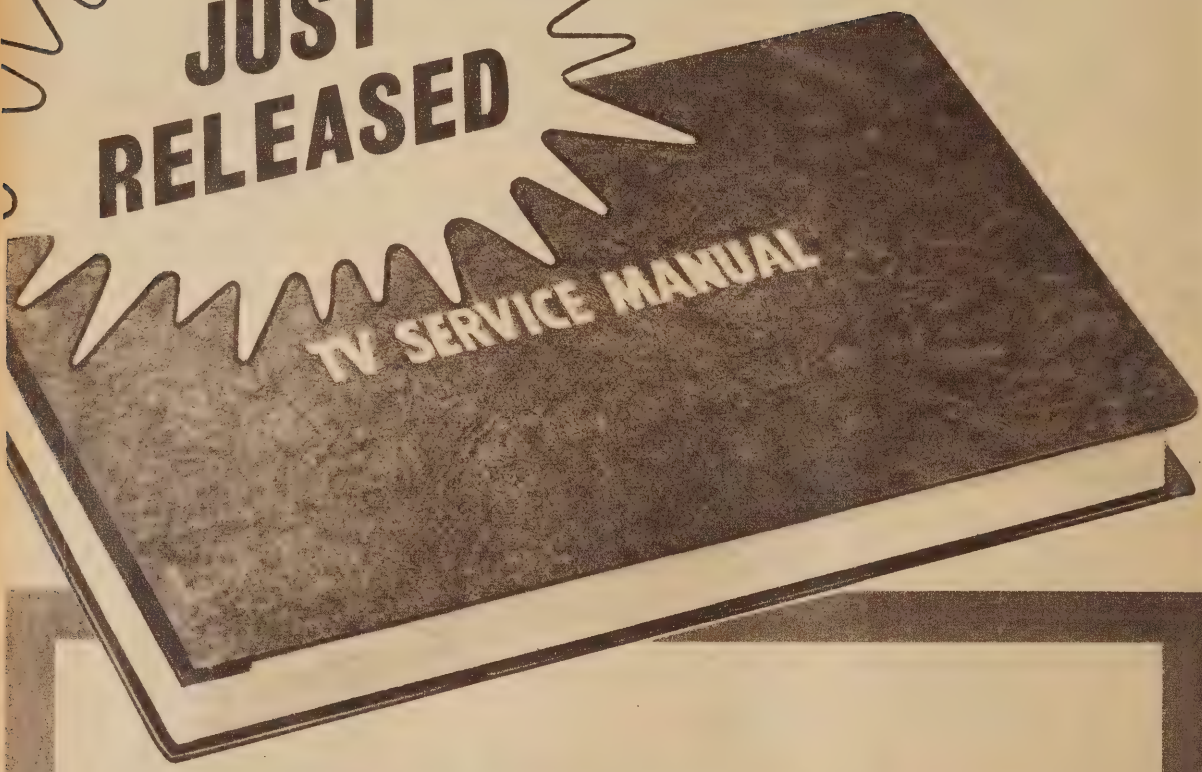


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plying this voltage by itself, and dividing the product by the resistance of the dummy load.

Using a steady tone of 1,000 cps, we obtained an audio output of 51.15 watts.

To check the tone, another resistor of low value is connected from one end of the dummy load to earth. From their junction a .01 mfd 2,000V capacitor is connected to a pair of headphones, the other side of the phones being earthed.

For a better check, a cathode-ray oscilloscope can be connected in place of the headphones, and the pattern checked to see that the waveshape is being preserved. Turning both controls off—or, better still, shorting out the grid of the driver stage—the CRO trace should be studied for any ripple caused by 100 cps "hum."

Having been built and tested, the modulator is now ready to be housed, together with the transmitter and power supply built last month.

The cabinet is made from one inch cored timber, which finishes ¾in. The two sides were cut from a sheet measuring 36in x 24in, leaving over a strip from which the back bottom bar was made.

The top piece (19-1/8in x 11¼in) and the two shelves (each 18-3/8in x 10¼in) came out of another length of 12in x 1in stock.

The bottom plate is cut from a sheet of 3/8in ply, 19-1/8in x 11¼in. (It could easily have been cut from 12in x 1in stock.)

Major constructional details are given in Fig. 2. The two side pieces are grooved ¾in across to take the two shelves. The first groove is cut 12 inches from the bottom, the next 12 inches above that point (or 11¼ inches above the top of the ¾in groove). These distances mean that the three front panels will meet snugly when the three chassis are pushed into their compartments.

The top piece has slots 3/8in deep x ¾in wide cut in each side to allow it to fit over the two side pieces. The bottom plate is cut the full area of 19-1/8 x 11¼ inches.

After a liberal dose of PVA glue, these pieces are fitted together and nailed with long nails. The four castors are then screwed to the baseplate.

Turning the cabinet around (see Fig. 3) a bottom bar is made 19-1/8 inches wide x 1¼ inches deep. This is nailed into position, and a groove made to allow the power flex to emerge when the "fly-screen" door is fitted.

When the frame door is made, and the hinges positioned and fitted, a sheet of copper gauze wire is placed over it, and four facing pieces (cut in the mitre box) nailed over it. (See Fig. 6).

We covered the inside of our cabinet with copper gauze wire to provide shielding against possible interference with television receivers.

The gauze can be pressed over the side, top and bottom pieces, and each shelf, before the cabinet is nailed together.

To finish off the unit, we bent up "runners" of angled aluminium and tacked them firmly into place at the junctions of the shelves and sides. The aluminium chassis slide in easily on these "runners," and they also help to make good electrical earth connections between the chassis and the gauze wire screen.

Two coats of white undercoat, and a final liberal coat of high gloss grey enamel, and the cabinet has a professional "studio" appearance.

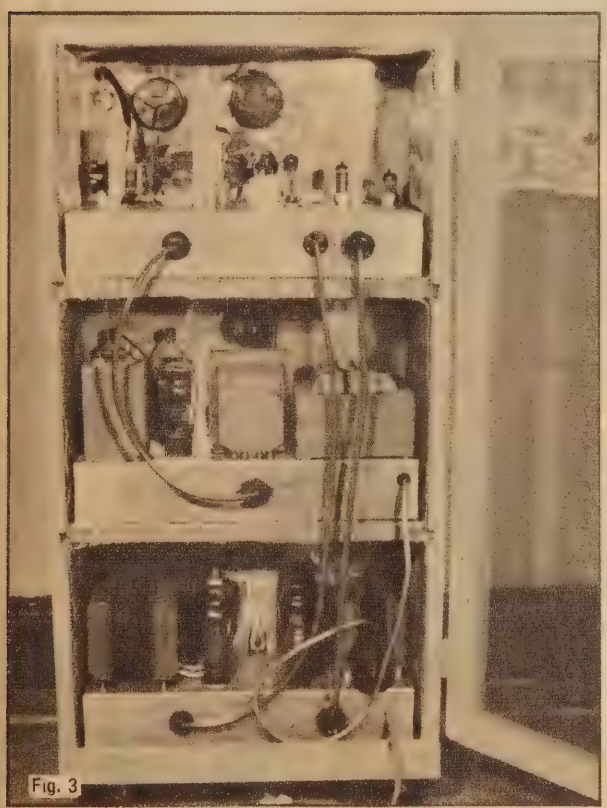

Fig. 3

☆

*A view of the complete cabinet with chassis fitted and the modulator in the centre section. Note the screen wire shielding on the shelves and walls, and on the rear door. This is a valuable precaution against TVI. With the door closed radiation from the cabinet is virtually negligible.*

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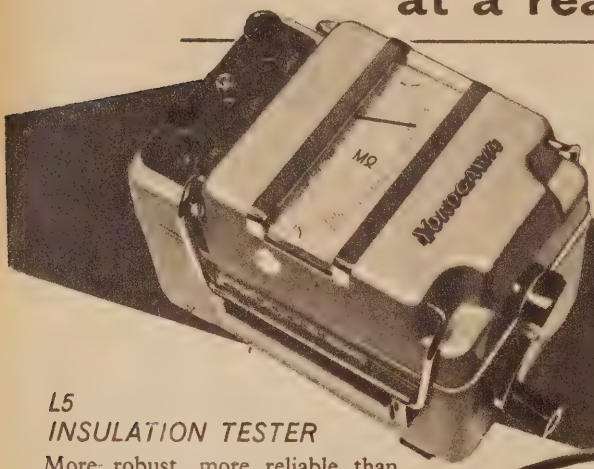


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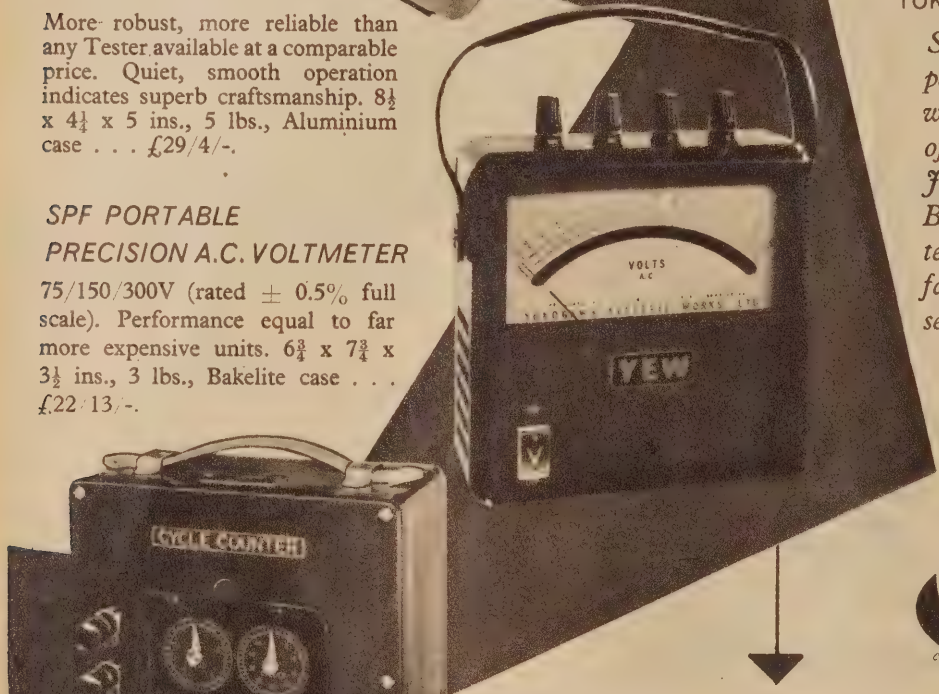

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# FROM THE SERVICEMAN WHO TELLS

**One doesn't normally expect to run into snow in the middle of a sunny, Sydney day but I did so recently. Nor was this ordinary snow; it was big, heavy "crawly" stuff, all over the screen of a client's television receiver.**

"SNOW," of course, is not an uncommon problem in television receivers. It is no respecter of seasons. It can be evident in deepest winter, or in the middle of summer.

Snow usually presents a problem when for any reason, the signals passing through a television receiver are barely sufficient for it to resolve into a picture.

In these circumstances the signal amplifying circuits in the receiver are likely to be operating at close to full gain, both by reason of the fact that the automatic gain control voltage has dropped to a minimum—automatically—and because the set user has doubtless advanced the contrast control towards maximum in an effort to get him a useable picture.

## VALVE HISS &c.

When an ordinary sound receiver is operated in equivalent condition, one usually expects to hear the sound program accompanied by a prominent hiss, due to electron noise in the valves and other components being amplified by the full gain of the set, along with the very weak signals.

In some cases, there will be interference and atmospheric noise as well although, in general, these are less of a problem at the higher frequencies used by television services.

In a television receiver, the output of the detector is used to modulate a light beam with the view to producing ultimately, a recognisable picture. But when the desired signal is mixed up with a liberal quantity of spurious signal, produced by random electron movement, the light pattern ceases to produce just the expected picture; it produces a picture plus spurious, random illumination.

And this is where accepted terminology becomes inadequate. We have grown so accustomed to describing as "noise" the result of random electron movement, that we don't seem to have a proper alternative term for it.

## CONVENIENT TERM

The best we can do is to call it "snow" when it disturbs our television picture, which leads to the rather ridiculous thought sequence that "noise" in radio components produces "snow" on a television screen.

But I suppose it's all right, provided we all know what we are talking about.

Well then, "snow" in a television receiver is usually traceable to one of three causes.

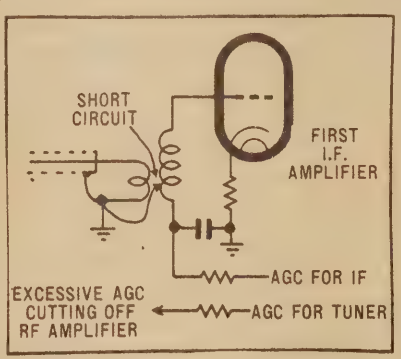
(1) Using the receiver in an area so remote from the stations or so "shadowed" by intervening topography that very little signal is available. "Countermeasures" involve using a receiver known to have a good fringe-area performance, and using an aerial having the highest possible gain in the best possible location.

(2) Operating a receiver in a reasonable signal area but with an inefficient aerial or a faulty aerial or feeder system.

(3) Failure of an RF amplifier valve or other portion of the signal input circuit, which causes the remainder of the circuits and particularly the IF amplifier system to operate at near full gain.

Random "noise" modulation, occurring along each of the scanning lines causes a minute agitation effect over the whole picture area, which we have come to describe as "snow." Except in very bad cases, its effect is easy enough to ignore at ordinary viewing distances, though very obvious close up.

But no one could possibly ignore the "snow" which I encountered on this particular occasion. (I am back to my story.) It was big, heavy stuff, which seemed visually to break up the picture into stubby black and white dashes. In fact, the picture was so completely broken up, that one could scarcely distinguish the villain from the heroine.




**Shorted AGC in the IF system caused it to operate at very high gain, while the RF amplifier was virtually cut off. Result . . . heavy "snow."**

Since it wasn't in a fringe or shadowed area, my first reaction was to check the feeder connections to the rear of the set, then follow it along to check for damage inside the room. Since everything appeared to be in order, I walked outside and inspected visually the feeder running up to the aerial, attached to the chimney.

As far as I could see, everything was in order but I had no intention of turning into a steeplejack, at this stage, for a closer look.

Back inside, I opened up the rear of the set and reached in to see if the RF amplifier valve was working.

"That's right," said the lady of the house, "you've fixed it; that was simple."

I'm afraid I reacted rather like a suitor who has been accepted before he's got round to proposing.

"But I haven't done anything yet," I replied.

It took a bit of a back-tracking to find what I had, in fact, done.

In reaching for the RF valve, I had disturbed the coaxial link running from the tuner to the IF system.

I found I could control the snow simply by pushing the link this way or that—which is something the weatherman has never been able to do.

## OBVIOUS CAUSE

One didn't have to be a genius to foresee the explanation. One side of the link circuit would be earthed and, presumably, one of the link terminal lugs in the first IF transformer was shorting intermittently to the grid secondary winding. This may have been affecting the signal path but, more particularly, it was shorting out the AGC voltage and causing the IF system to operate at full gain.

The temptation in the circumstances was to find a piece of string and simply tie the cable in a position where the short did not occur. However, since the cable disappeared through a grommet to the underside of the chassis, there was no way of knowing how effective such an emergency measure might be.

To cure the "simple" fault, would involve removing the chassis from the cabinet, disconnecting and opening the IF can with the further risk of upsetting the alignment in so doing. This might then mean a complete alignment procedure.

Since there was nothing else for it, I proceeded to remove the chassis and then, very carefully, the IF can. As I had expected, one of the terminal lugs serving the coupling link was loose in the base and rather misshapen, allowing it to bite into the secondary winding. I simply had to bend it away, replace the transformer and the job was done.

Fortunately, there was no sign of the alignment having been disturbed in the process, so I was saved that complication.

## AGC CIRCUIT

Oh yes, the AGC. The receiver proved to have the usual double AGC circuit, one branch serving the IF system, the other serving the tuner. Since the IF AGC was shorted out, the IF system alone operated at full gain. But this set had a four-stage IF system and "full gain" was very full indeed.

With no control on the IF system, the AGC reaching the tuner was sufficient to cut off the RF amplifier completely, so that the only signal reaching the mixer was by stray leakage through the attendant components and capacitances.

Thus the receiver was operating with the barest minimum of signal at the converter grid, but with the full gain of a four-stage IF system, amplifying

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it thereafter, along with every vestige of valve and circuit noise.

Little wonder, there was heavy snow on a sunny day.

I mentioned, last month, a professional man who had trouble with the aerial for his broadcast tuner. A week later, he was after me again, this time to do with counterweighting a pickup. Perhaps others may be faced with a similar problem and may find a few remarks helpful.

It seems that our friend had been reading about the weight on a pick-up stylus and, prompted by curiosity, had invested a few shillings on a little balance to measure it.

He found that his own pick-up was pushing the stylus down with a weight of 6 grams, which was a bit too heavy for his liking. The trouble was that he could find no provisions for adjustment on the pick-up arm.

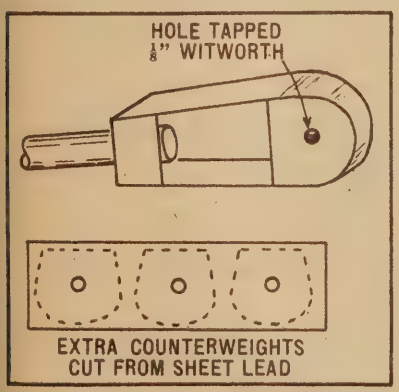
Could I help?

## SEVERAL ASPECTS

I had to explain, first of all, that there was more to it than merely reducing the weight on the stylus point. Whether a pick-up stylus would stay in the groove with reduced downward pressure depended partly on the balance and suspension of the arm and partly on the design of the pick-up head.

If the arm bearings exhibited appreciable friction, either sideways or up and down, the head would not follow the inevitable undulations of a record. In the case of a record changer—his wasn't one—operation of the trip or stop mechanism could introduce additional stiffness over the inner grooves.

Again, any accidental tilt on the turntable, or pick-up mounting or motorboard as a whole, could throw the pick-up one way or other and cause it to jump grooves with too little downward pressure.




**A simple method of adding extra counterweight to some pickups. Drill and tap the existing weight and use a screw to secure weights cut from sheet lead.**

As far as the head itself was concerned, the stylus was being pushed violently from side to side—and also up and down with stereo—by the groove modulation. If the stylus movement in the head was too stiff, heavy groove modulation could easily kick the whole head away and out of the groove.

In more technical terms, low stylus pressure had to be accompanied by high stylus compliance.

Armed with this background information, our friend spent time that evening checking up on these things, as far as he could, and also experimenting with reduced stylus pressure.

The pick-up arm was a type in which vertical movement relied on the compliance of a nylon "hinge," and there seemed to be no problem there.

It pivoted horizontally on an ordinary shaft and bearing, resting on a ball thrust. He cleaned this and lubricated it with a film of what he assured me later, was a very light oil. Everything seemed quite free.

With a small level borrowed from a carpenter-neighbour, he checked the motorboard and turntable and found this also to be okay.

The cartridge seemed to have a slight tilt when viewed from the front, so he adjusted the arm to get the body of the cartridge parallel with the record surface. With the particular unit, the arm and head can be adjusted axially.

This done, he began experimenting with the stylus pressure, reducing it by the simple expedient of attaching coins to the existing counterweight with a rubber band which had arrived that morning around his newspaper.

Yes, the pick-up would track his most heavily modulated records with a weight of between 3 and 4 grams. But he didn't altogether like the look of the coins strapped to its back.

Accordingly, he turned up at my shop with the pickup arm—an easily demountable type—complete with coins and rubber band. Could I suggest something a little less makeshift?

The obvious thing was to attach an equivalent amount of weight underneath the counterweight, which already constituted the rear end of the pick-up arm. But fancy having to file a weight out of steel or iron or brass or copper or what? Make it too big and one would have a half hour's work getting it down to size; too small and he'd have to start over again.

Then I had an inspiration. Many moons ago I'd stowed away a small roll of sheet lead which a plumber or somebody had left on the job. It was about a sixteenth-inch thick and soft enough to cut with snips, cutters, pincers—in fact, almost anything.

The rest was easy. I drilled a small hole in the rear centre of the pickup's own counterweight and tapped it 1/8-inch whitworth. My tin yielded two or three "radio" screws and washers to fit the newly tapped hole.

The last item was a strip of lead sheet with a few holes drilled at strategic spots.

All my client had to do was to cut himself a counterweight or two, trimming them and smoothing them with a scrap of emery paper to get just the right weight and the right appearance.

He didn't have to be too cautious, because it was so easy to start all over again.

He rang me up again next day, with a smile all over his voice. To be sure, I didn't make much of a profit on the job

## HAZARDS OF LITERAL TRANSLATION

*GLANCING through the English version of a French trade magazine recently I came across the following rather surprising statement, relevant to the growth of a particular firm:*

*"... including these contracts, the total of foreign orders entered on the books of —— during 1959 now amounts to 4,000,000 New Francs."*

*I only hope some of my colleagues from the old radio factory days read this. I'm sure it would come as a severe shock to most of them, who rather regarded themselves as experts in this particular field.*

*But 4,000,000 francs worth? Brother, that's a lot of foreign orders!*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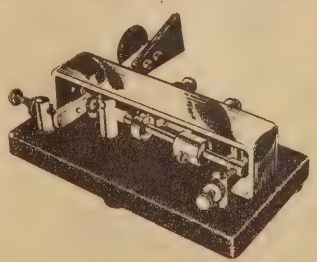

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Slightly less in N.S.W.

but I reckon that I'll have a "corner" on any future work or sales, as far as he is concerned.

So much for my "Boy Scout" lore—good deeds and all that.

There's an old ditty which seeks an answer to the question "what happens to the breakdown van, when the breakdown van breaks down?"

At least that's how I think it goes.

What brought that on? Well simply the thought that a serviceman sometimes has to repair his own service gear.

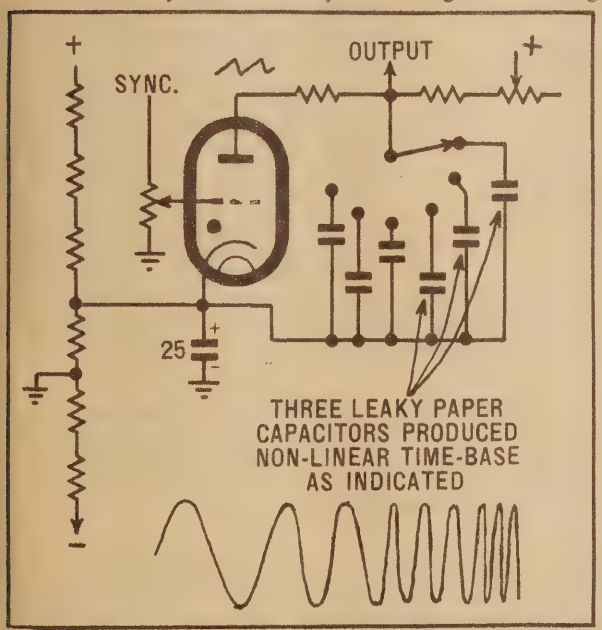
There's nothing very sensational about the story to follow, except that it concerns a circumstance which I have never before encountered personally and which I have never before seen mentioned in print.

That last may merely be because I have never noticed it.

## OLD FAITHFUL

However, the other day, I went to do an odd job with a public address amplifier and, while so doing, connected to its output an old but still useful "audio" CRO, which I've owned almost since entering the game. It showed me what I wanted to know but it also reminded me about something I'd noticed before—the timebase was very nonlinear.

It hadn't always been that way and I decided, there and then, to find out why.




☆

**After a few years in service, most tubular paper capacitors become leaky. In this CRO timebase they produced severe non-linearity.**

☆

I mentally summed up some of the possible reasons why a time-base should be non-linear:

(1) The B-plus rectifier could be weak, reducing the voltage to the gas triode. It would also reduce the voltage to the horizontal amplifier and make it tend to overload, causing non-linear sweep. But, if so, why was the vertical amplifier still okay?

(2) There could be something wrong with the operating conditions of the gas triode. If there was too much bias, for example, the plate capacitor would be charging over too much of the charge cycle, causing non-linearity. But, if so, why was the output of the timebase apparently no greater than usual?

(3) There could be something wrong with the horizontal amplifier alone, causing non-linear amplification of the input cycle. I decided that this was a most likely explanation.

These thoughts, of course, were being had while I was busily removing the CRO from its case to bare the innards.

But actual checking very quickly got me nowhere. The B-plus voltage was quite normal. There seemed to be nothing unusual about the bias for the gas triode and I didn't have a replacement to check the valve. Plate, screen and cathode potentials of the amplifier stage were normal, indicating no apparent malfunction here.

So I had a closer look at the non-linearity and discovered something mighty interesting.

The non-linearity was apparent only over the lowest three ranges, which I had so commonly used for audio testing. On the other ranges, it was quite normal; for all practical purposes, the linearity there was perfect.

Ha, poor low frequency performance. There was an electrolytic somewhere which had lost its capacitance.

But there wasn't. Paralleling others across them made nary a whisker of difference. Besides, why the abrupt difference in performance between two adjacent ranges, which virtually overlapped in coverage.

Then I had a look at the switch and noticed the fact that the lower three ranges—the ones giving the trouble—all had tubular capacitors in the charge circuit. The other ranges had mica capacitors. Maybe the tubulars were faulty.

I didn't like having to remove them, since they were stacked on a panel but needs must and out they came. The R/C bridge told the rest of the story. Every one of them showed an artificially high value of capacitance and I had to spin the Power Factor knob like a steering wheel to get the eye to open to full null.

The dielectric in the capacitors was so full of moisture that they were half-way to electrolytics.

I put in three new capacitors of the correct marked value and bingo—the three ranges were back to the old order of linearity.

Since I have no monoply of old and leaky capacitors, it set me wondering how many other oscillographs around the place might be afflicted similarly.


The RADIOMASTER

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**Mullard Amplifiers and Kits also available.**
Packing included. Freight extra.

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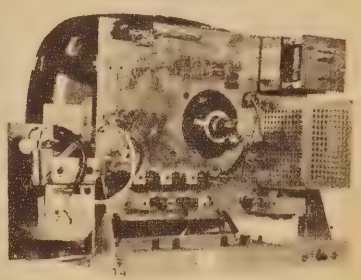

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**Telephone LM5580.**

*The cabinet of the completed receiver is leatherette covered and is of similar design to the earlier "Transporta" models. The speaker grill is of gold coloured expanded aluminium.*

# The New Transporta Seven—With RF Stage

**This new design in the popular "Transporta" series presents a worthwhile improvement in performance which will prove of interest to the "out of town" listener and also to those requiring a set for more than just local listening. In this article we describe the construction of a set incorporating an RF stage and using the new type drift transistors.**

IN the February, 1959 issue we described the Transporta Seven, a receiver incorporating worthwhile improvements in gain and selectivity over the original "Transporta Six." These improvements were achieved by the addition of a second IF amplifier stage.

It was also pointed out that similar results could be achieved by the addition of an RF amplifier stage.

## NO TRANSISTORS

At the time, reasonably priced transistors, suitable for RF amplifier application, were not readily available and the possibility of using such a circuit had to be temporarily postponed.

Recently, however, such transistors were released on the local market and we felt that a description of a receiver incorporating these new "drift" transistors was now warranted.

We were very happy, therefore, when one of our advertisers came to light with a set of coils and a printed wiring board designed for just such a set as we had in mind. Subsequently, we built up a set using the coils and board provided and, after some modifications, the performance came well up to our expectations.

The new design incorporates an RF amplifier stage and a single stage, high gain IF amplifier.

The upper frequency limit of a junction transistor is determined by the base transit time or the time interval required for the charge carriers or "holes" to move across the base region from the emitter to the collector. The collector/base capacitance is a further factor in determining this upper limit.

In the drift transistor, the base transit time is appreciably shortened by the introduction of impurities into the base material in such a manner that an electric field is set up in the base region, which accelerates the charge carriers across the base from emitter to collector.

The density of the impurity is carefully graded throughout the base material by a diffusion process so that a high impurity density near the emitter results in a low base resistance and a low impurity density near the collector contributes to a low collector-base capacitance and also results in a high collector breakdown voltage.

The result is a transistor capable of substantial gain not only on the broadcast band, but also well into the short wave band, given suitable coils and circuitry. And, most important, such units may be made at a reasonable cost, making them only a little dearer than the less specialised types.

## WHY THE RF STAGE

Which brings us to a discussion of the RF stage and its advantages. In any receiver, the limit of useful sensitivity is determined by the amount of noise generated within the set itself. By far the greatest contributor to this noise is the converter stage, and transistor designs are as serious offenders in this regard as their valve counterparts.

When high overall gain is procured by IF amplification alone, the converter noise is amplified equally with the signal so that, while sensitivity is increased, the signal to noise ratio remains more or less constant.

On the other hand, by providing signal amplification ahead of the converter stage, it is possible to increase the level of the desired signal without, at the same time, appreciably increasing the receiver noise level. The inherent noise of an RF amplifier can be kept quite low by proper design.

It can be seen therefore, that, of the methods available for improving receiver gain and selectivity, the RF amplifier has a definite advantage over the IF amplifier as far as noise and, consequently, the ultimate sensitivity is concerned.

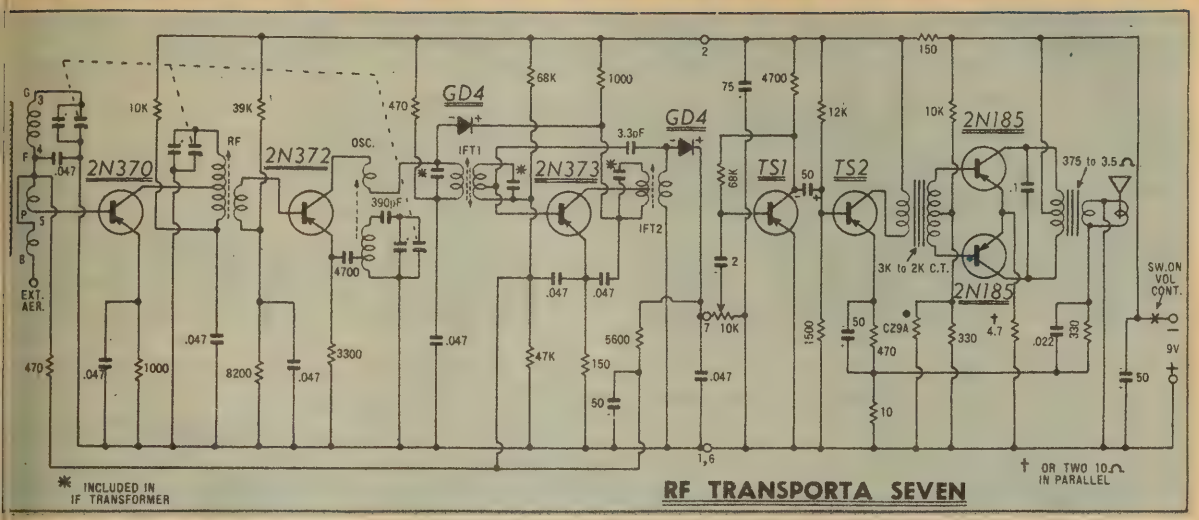
Any attempt to increase the gain simply by additional audio amplification gives no improvement in either selectivity or signal to noise ratio.

Due to the lesser number of tuned circuits in the IF stage, the overall IF selectivity of the new set may not be as good as the original "Transporta Seven" but this is largely compensated for by the additional selectivity afforded by the tuned circuits of the RF stage. In practice therefore, the ultimate selectivity will be very close to that of the original set, giving adequate separation even between stations grouped closely together on the band.

All the foregoing is not intended as a

**By Alan Nutt**

# CIRCUIT HAS RF STAGE FOR TOP PERFORMANCE




***The addition of an RF amplifier stage gives this receiver a much improved signal to noise ratio, thereby providing a higher level of useful sensitivity than otherwise possible. The neutralising capacitor, if required, should be mounted under the printed board as described in the text.***

ticism of the original Transporta ven, or as a suggestion that owners ould immediately scrap their present del for the new one. For purely al listening in and near the suburban as, it will prove more than adequate, has been demonstrated. However, en well out in the country, where nals are weak, the new set will have a finite "edge" on the old one.

The two stage IF channel of the earl- set was purposely designed to oper- at less than the maximum obtainable n per stage in the interests of stable eration. Our new design uses high n IF transformers and its perform- e approaches that of the two stage sion as far as sensitivity is concerned.

Due to slight varations in transistor aracteristics, some sets may show a dency to oscillation in the IF chan- whereas other sets may be com- tely free of this trouble. The in- bility, if present, may show up as a finite swishiness on stations or pos- ly, in severe cases, straight out oscil- ion.

## NEUTRALISING

In order to make provision for every e that may arise, we have included a utralising capacitor in the IF stage. his is in keeping with the transistor nufacturer's recommendation for this uit and proves very effective in elim- ting any undesirable "bugs" that may present.

However, this is a matter for the in- idual constructor to decide, and we uld suggest that the set be first con- ucted omitting the neutralising capaci- . Should it then be felt that the set not as smooth in operation as could desired, 2 or 3 picofarads of capacity y be tried in the position indicated in circuit diagram.

Another circuit detail worthy of com- nt is the AVC system. This AVC on is excellent, the set being operat- in the shadow (literally!) of one of the al transmitters without sign of over- d.

AVC control is due firstly to the appli- cation of a DC voltage, derived from carrier rectification at the detector, to the base of both the IF and RF ampli- fiers. This voltage causes a reduction in the base bias current and the gain of both stages is consequently reduced. Further control is provided by the shunt action of the GD4 diode connected be- tween the collector of the 2N372 and RF ground.

The action of the shunt diode is as follows. The voltage drop across the 470 ohm resistor in the 2N372 collector supply lead is practically constant for all signal levels. On weak signals the voltage drop across the 1000 ohm re- sistor in the 2N373 collector supply lead is slightly more than the drop across the 470 ohm in the 2N372 collector supply and therefore a small reverse voltage appears across the diode.

## PARTS LIST

1 Cabinet; internal dimensions 9¾ by 6 1/8in. by 3 inches.
1 Baseplate 9½ by 5½ inches.
1 Aerial rod mounting bracket.
1 5in. diameter speaker, 3.5 ohm voice coil.
1 Output transformer, 375 ohms CT to 3.5 ohms.
1 Driver transformer, 3000 ohms to 2000 ohms CT.
1 3 gang 300pf tuning capacitor.
3 3-30pf trimmer capacitors.
1 Special coil kit comprising aerial rod and coil, RF coil, oscillator coil, double tuned 1st IF transformer and 2nd IF transformer. (See text.)
1 Calibrated tuning knob.
1 Volume control knob.
2 GD4 germanium diodes.
1 CZ9A thermistor.
1 10K ohm potentiometer with switch.
1 Printed circuit board RF section.
1 Printed circuit board AF section.

### TRANSISTORS

1 2N370
1 2N372
1 2N373
1 TS1
1 TS2
2 2N185

### RESISTORS—all ½ watt.

2 68K
1 47K
1 39K
1 12K
2 10K
1 8.2K
1 5.6K
1 4.7K
1 3.3K
1 1.5K
2 1K
3 470 ohm
2 330 ohm
2 150 ohm
1 10 ohm
1 4.7 ohm (or two 10 ohm in parallel).

### CAPACITORS

1 75 mfd. electro. 12VW.
4 50 mfd. electro. 12VW.
1 2 mfd. electro. 12VW.
1 .1 mfd. paper or disc ceramic, 200V.
8 .047 mfd. paper or disc ceramic, 200V.
1 .022 mfd. paper or disc ceramic, 200V.
1 .0047 mfd. disc ceramic.
1 390 pf. 5% tol. (padder).

### SUNDRIES

Hookup wire, spaghetti tubing, solder, 9-volt battery, rubber grommets ⅜" ID., battery plug, 8 ½" by 1" bolts and nuts, 6 ½" by ¼" bolts and nuts.

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**Magnetic Sound INDUSTRIES** give you

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**on any Tape Recorder you choose. This offer is definitely exclusive to Magnetic Sound Industries — compare with most other Stores' 3 months.**

## AVON

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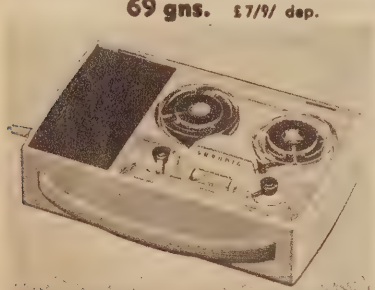
**69 gns.** £7/9/ dep.



## GRUNDIG CUB

Now a fully portable Tape Recorder from the fabulous Grundig Organisation. The Cub weighs only 5lb, and this amazing price includes microphone, built-in speaker and batteries.

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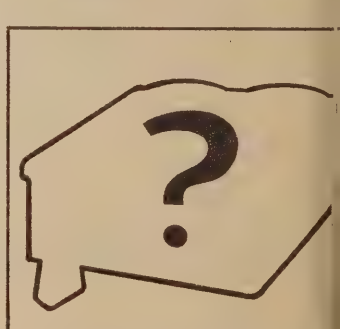


A famous B.S.R Tape Recorder will b our Store by the time this publication to Press. It has many fine features make it a real winner, at its special price. The first release of this model c to Magnetic Sound Industries at

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**Magnetic Sound INDUSTRIES**

**387 George St. (2 doors from Kodak). BX4440, BX4587**

In this condition the diode is non-nducting and has negligible effect on e operation of the set.

At high signal levels, the 2N373 aws less collector current and the volt-ge rises at the junction of the diode thode and the 1000 ohm resistor, be-oming more and more negative until e point is reached where the cathode more negative than the anode.

At this point the diode begins to con-uct and places a heavy shunt load fectively across the primary of IFT.1 ereby reducing the stage gain.

The audio section of the set needs ttle introduction, being the same as ecified for the original "Transporta even." Briefly it consists of a TS1 ansistor operating as an RC amplifier llowed by a TS2 driving a pair of N185's operating in class B as the out-ut stage.

## THER TYPES

It is possible to substitute an OC70, OC71 and a pair of OC72 transistors the audio board without altering the rcuitry in any way. However, it is not dvisable to use alternate types in the F unit as some circuit modifications ould be required and there is also the ssibility of instability.

On the construction side, the set fol-ws a similar pattern to the "Trans-rta Seven."

Two printed wiring boards, one for e audio circuitry and the other for the F and IF stages, are mounted on a etal base plate which also carries the udspeaker and the volume control. The ew RF board has the same physical imensions as the old one, meaning that e same base plate, cabinet, etc., may e used if it is planned to convert an ld Transporta Seven to the new design.

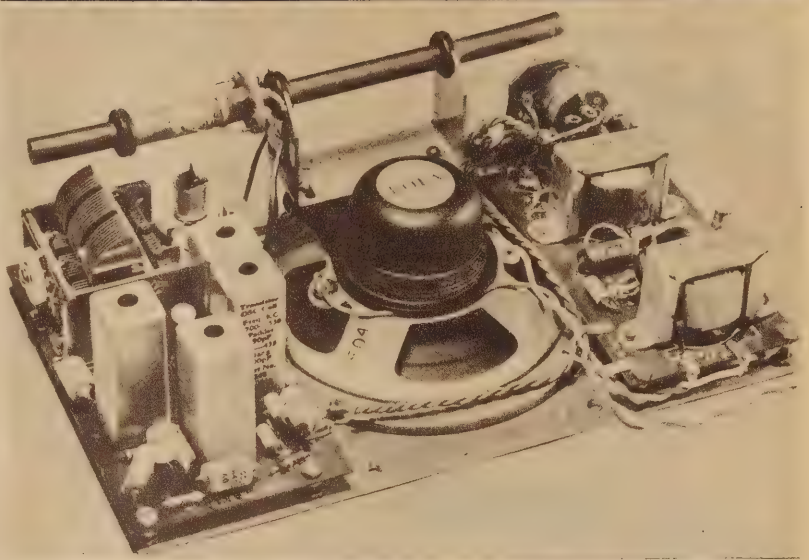
The advertiser we mentioned pre-iously, R.C.S. Radio Pty. Ltd., has dvised that the new printed boards will be available in quantity by the time this appears in print. Boards for the audio section are a standard item which has been available for some time.

The same manufacturer is also making available a complete kit of coils includ-ing the IF transformers and a ferrite rod aerial assembly.

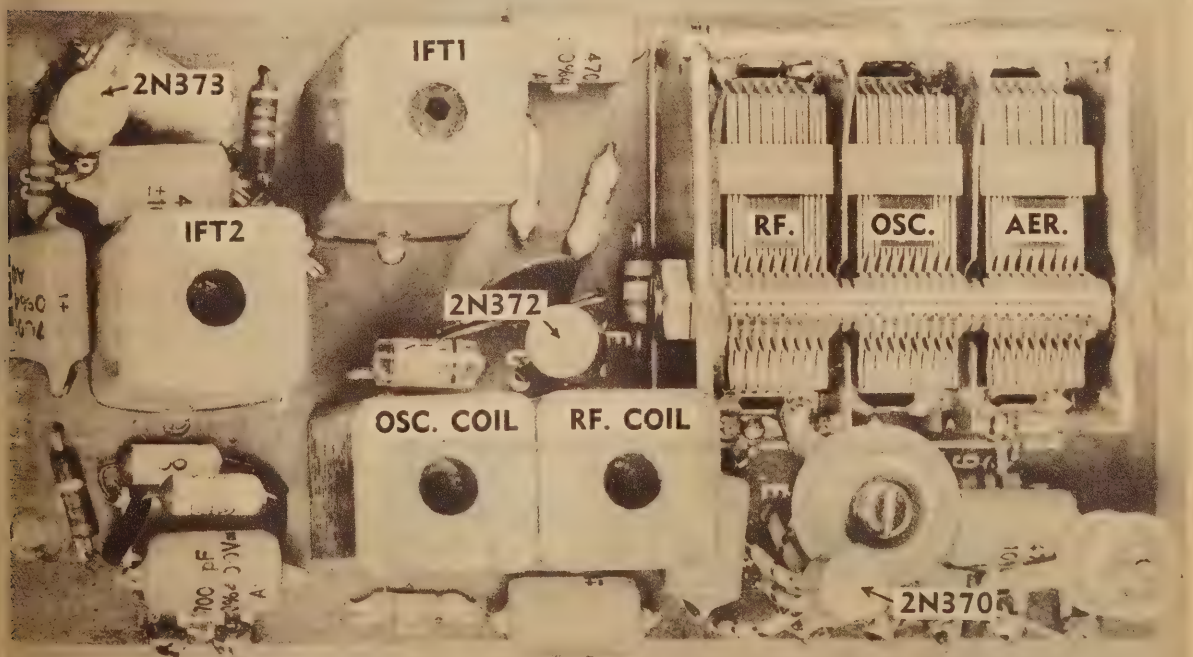
From the photographs and diagram the assembly of the components onto the wiring boards should be quite clear. Mount all the small components on the audio panel before assembling the trans-formers.

In a similar manner, mount all the small components on the RF board, in-cluding the transistors, fitting the tuning capacitor and coils last of all. After mounting on the board, the lugs of the coils and IF transformers should be bent in the direction indicated in the RF panel layout diagram. If neutralising is required, the small capacitor may be connected under the wiring board from

# LAYOUT AND ASSEMBLY DETAILS



*The completed panels shown mounted on the base plate either side of the loudspeaker. Note the method of mounting the ferrite rod and aerial coil. The latter should be left quite free to slide on the rod for the purpose of alignment.*




*This photograph shows the layout of all the components on the RF panel. The oscillator trimmer was later replaced with a concentric type in order to facilitate the alignment of the receiver after placing in the cabinet. The board is the same physical size as other Transporta "front end" boards, so that the original chassis may still be used.*

***Now! At Mastersound . .***

**Jason**

# TEST EQUIPMENT KITS

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**VALVE VOLTMETER EM10.** A four-valve bridge circuit gives good stability. May be used as a general-purpose meter since there are 23 ranges, including D.C. current ranges. Price, kit £35, plus Sales Tax 12½%.

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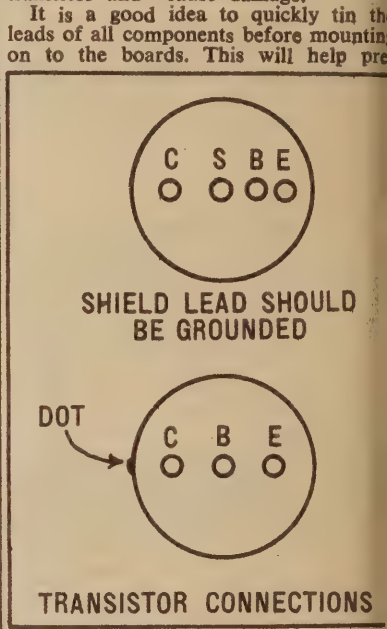
the base of the 2N373 to the anode connection of the detector diode.

Without labouring the point, we must mention again that transistors are extremely sensitive to temperature change and must be protected from excessive heat, particularly while being soldered in to position.

Do not cut the leads shorter than about one inch, and hold the lead with a pair of pliers while soldering in order to carry away any heat that would otherwise be conducted into the body of the transistor and cause damage.

It is a good idea to quickly tin the leads of all components before mounting on to the boards. This will help prevent too much heat being applied to the board and components during the actual assembly.




***The above diagram will assist in identifying the leads on the transistors. The lead marked "S" or shield should be grounded at the nearest convenient point on the board.***

Notice that the three drift transistors each have four connecting leads. Three of the leads are grouped close together being the emitter, base and shield connections. The lead slightly separated from the other three is the collector connection. An earthing hole is provided in the wiring board for each transistor and the shield lead should be grounded at this point.

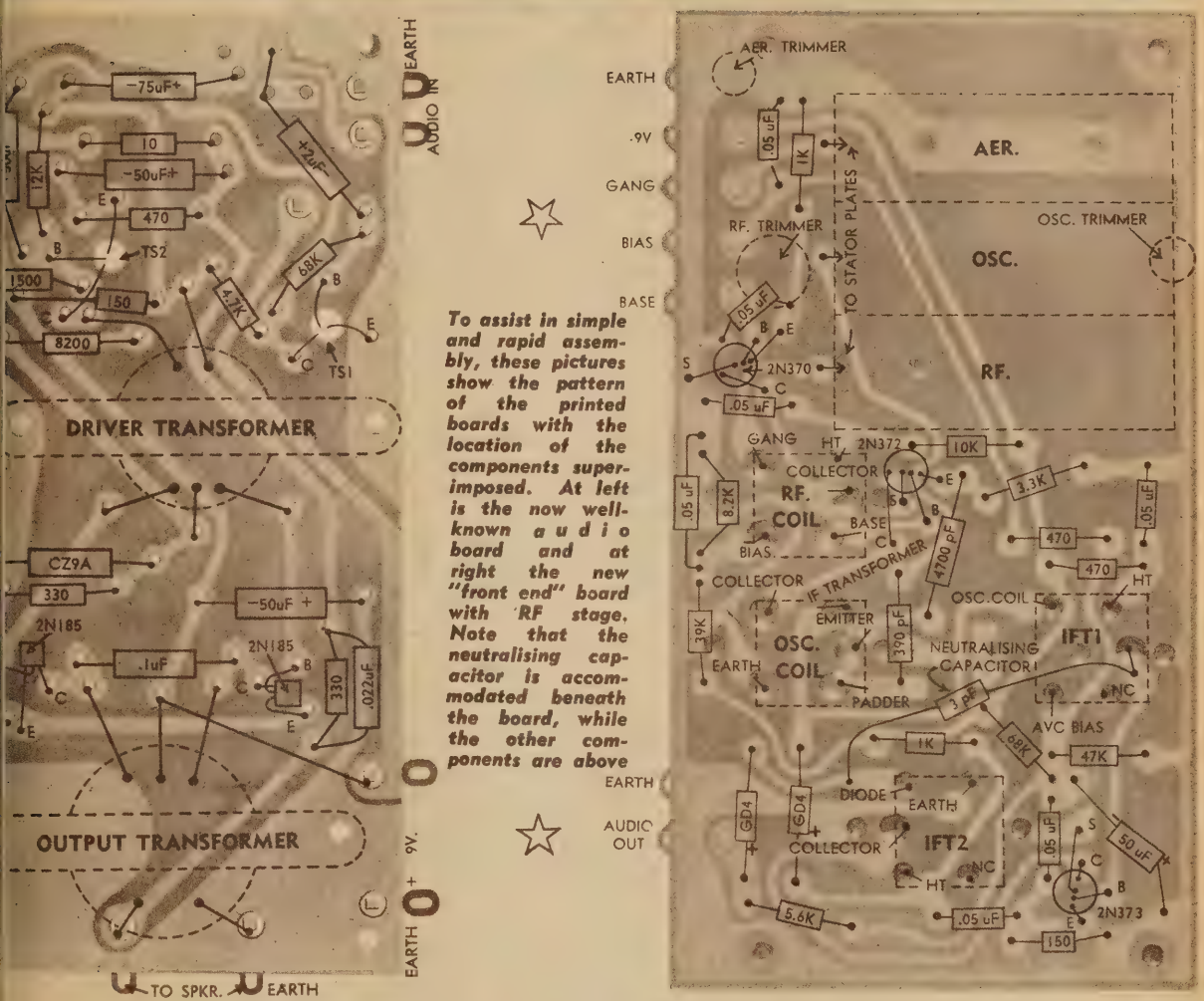
## CAPACITOR TYPES

The physical size of the paper capacitors on the RF board is important from the assembly point of view. If they are too large it will not be possible to fit them on to the board in the places already marked. The units we used measured 3/8in by 5/8in and proved quite satisfactory.

Although the oscillator trimmer shown in the photographs mounted on the side of the middle section of the tuning gang, we found, after some experiment, that alignment was facilitated somewhat by changing its position.

We substituted a concentric type trimmer for the compression type shown, soldering it upright by its centre spindle to the same point on the tuning gang support rod as the ground connection of the original compression trimmer. A short length of tinned copper wire was

# DIAGRAMS SIMPLIFY PRINTED BOARD ASSEMBLY




***To assist in simple and rapid assembly, these pictures show the pattern of the printed boards with the location of the components superimposed. At left is the now well-known audio board and at right the new "front end" board with RF stage. Note that the neutralising capacitor is accommodated beneath the board, while the other components are above***

hen run from the "hot" side of the trimmer to the stator lug of the gang. In his way the trimmer is still accessible with the set mounted in the case.

It is a good idea to thoroughly tin he gang support rod at the spot where the trimmer is to be attached, as a faulty soldered joint at this point can cause the tuning of the set to be very erratic.

## FINAL STEPS

After completing the component assembly, both boards may be mounted on the base plate holding the loudspeaker. The volume control should also be fitted and all connecting wires between the two panels fitted in position.

Leave about nine inches of wire for the battery lead. Care should be taken when fitting the battery plug as a reversal of polarity will ruin the transistors.

The ferrite rod aerial may now be assembled and a grommet should be pushed onto the rod about 3½in from one end. Slip the aerial coil onto the rod from the same end, the pins of the coil bearing against the grommet.

A second grommet is now pushed on from the other end and so spaced from the first one that the two together fit into the slots in the bracket attached to the speaker frame. The coil should be left quite free to slide along the rod. Bend the lugs on the coil at right angles and attach the wires from the appropriate lugs on the RF board.

It may be necessary to raise the mounting bracket above the speaker frame about ¼in in order that the rod will clear the tuning capacitor rotor plates. This may be accomplished simply by inserting several washers between the bracket and speaker frame.

After checking over the wiring for possible errors, connect the nine volt battery and switch on. Even before alignment it should be possible to tune at least some of the local broadcast stations at good strength.

Although some manufacturers state that the cores in their coils are pretuned, due to slight variations in the construction of individual sets, it may be found that the pretuned setting is not optimum. It is a wise precaution, therefore, to carry out a full alignment on the completed set.

Ideally, this alignment should be undertaken with the aid of a signal generator. However, should one not be available, it is not a difficult matter to align the set satisfactorily by using the signals from the local broadcast stations.

A point to notice is, that due to AVC action, a strong local signal will make the alignment of the front-end seem very broad and may also cause "pulling" of the local oscillator frequency. The best rule is to use the weakest input signal that will still give a satisfactory output indication. The aerial may be oriented so that the strength of a local station is reduced to a satisfactory level.

The first step is to set the tuning dial knob so that with the tuning capacitor fully in mesh, the line marking the end of the dial scale is opposite the pointer or indicator mark on the case.

## LOW FREQUENCY END

Assuming that the tuning of the IF transformers is reasonably correct, a station near the low frequency end of the dial should now be tuned in and the core of the oscillator coil adjusted to bring the dial calibration opposite the pointer. Tune to a known station at the high frequency end of the band and by means of the oscillator trimmer capacitor, again bring the dial calibration opposite the pointer.

Retune to the station at the end of the band and adjust the core of the RF coil for maximum output from the speaker. Then adjust the aerial coil, sliding it along the ferrite rod until a definite

**(Continued on Page 83)**

# Here's your answer, Tom!

**Following on from last month, we are continuing the discussion of measuring instruments. The topic this month is the Electronic or Vacum Tube Voltmeter, which uses thermionic valves to increase the sensitivity of a moving coil meter. The principle of the valve operation is used as an introduction to the discussion.**

**By Jamieson Rowe**

AS we found earlier, all substances are composed of tiny "solar systems" called atoms, consisting themselves of a quantity of electrons orbiting around a central nucleus. In substances called conductors (such as metals) the electrons in the outer orbits are rather loosely held by the field of the nucleus, and may be lost if they become "energetic" or are pulled off in some way.

## ENERGY SUPPLIED

We saw that the application of a potential difference (PD) to such a material can supply these outer electrons with sufficient energy to escape from their orbit, and we also saw that thermal (heat) energy gives this energy to the electrons, causing the so-called "random thermal currents."

As you would expect, the hotter the material, the higher is the thermal energy given to the electrons and the stronger the thermal currents. Also, in good conductors such as most metals, the electrons are freed relatively easily. Thus, it is not surprising to find that a lump of metal at a high temperature has quite high thermal currents.

In fact, some of the electrons in such a lump attain so much kinetic energy that they actually fly from the surface of the metal. They may return to it immediately or remain, for a period, in the space surrounding it. If the metal is surrounded by air or some other gas, these free electrons may be "captured" by one of the gas molecules, forming a negative gas ion.

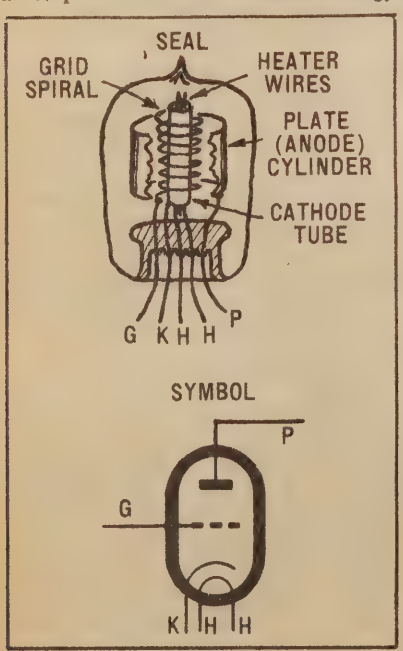



*Fig. 2. The triode valve uses a third electrode, the grid, to control the flow of electrons from cathode to plate.*

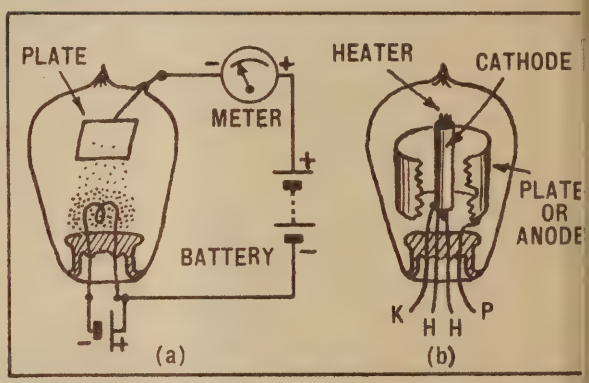



*Fig. 1. Here are the two types of thermionic diode valve, first step in the evolution of the modern valve from the incandescent bulb.*

## PLACED IN VACUUM

If the heated metal is placed in a vacuum, however, or in one of the "inert" gases which are unable to capture free electrons, these free electrons remain in a sort of "cloud" around the metal. The space around the metal thus has a lot of little negative charges in it, and the cloud of electrons is called a SPACE CHARGE.

A normal incandescent light bulb is an example of this. The filament, made of tungsten, is heated electrically in a vacuum or in an inert gas, such as argon. It emits light, which we use for normal visual purposes, but it also has a cloud of electrons surrounding it, the space charge, which we do not use.

The great American inventor, Thomas Alva Edison, discovered in 1883 that a metal plate introduced into the bulb near the heated filament, and made positive with respect to it, attracted electrons from the space charge. Thus a current could be measured, flowing between the plate and the filament. (This is in accord with "conventional" current flow—electrons are actually flowing from filament to plate.)

Figure 1 (a) shows this effect. The meter registers a current, showing that the plate attracts and captures some of the space charge electrons. Thus was born the simple diode valve.

This simple device is of considerable practical use, but possesses a number of disadvantages. One is that the potential between the filament and the plate is not constant for the total filament, sinc the filament has a voltage drop alor it, due to its heating current. Th causes "hum" modulation of the pla current, if we try to heat the filame with other than direct current.

To solve this problem, the princip of indirect heating was evolved. Th uses a filament or heater to heat cylinder or "cathode" placed around i It is the cathode which is used as th negative electrode of the unit, the heat being used merely to raise its temper ture. Thus the cathode has no voltag drop over its surface, and is called "unipotential" cathode.

This allows a periodically reversir or alternating current to be used to he the emissive surface without having th current superimpose its waveform on th main cathode-plate current. Figure 1 ( shows the indirectly heated diode, mac with the plate in cylindrical form to i crease efficiency.

## TRIODE INVENTED

In 1906, Dr Lee De Forest modifie the diode by inserting a third electroc between the cathode and the plate. Th electrode, called the "grid," is in th form of a wire spiral placed so that is in the path of electrons passing fro cathode to plate.

It is found that, if this grid is place at a negative potential with respect the cathode, the cathode-plate flow electrons in the valve is decreased. fact, a certain negative voltage effe tively "cuts off" the cathode-plate cu rent. This voltage is usually quite sma compared with the plate-cathode voltag of the valve, but it can control qui large cathode-plate currents.

Thus a small variation in the negati voltage on the grid causes a large vari tion in the cathode-plate current. fairly large resistance placed in seri

ith the plate will have a large variation
the voltage drop across it and thus
ie triode valve, as it is called, can
nplify voltage changes.

Since the grid draws no current (prac-
cally) from its source, the input power
the valve is effectively zero; thus the
put resistance is very high. It is this
roperty which leads to the use of valves
voltage measuring instruments, and
hich concerns us here. Other properties
f valves will interest us in future dis-
ussions.

Consider the circuit shown in Figure
. An unknown voltage applied between
ie grid and cathode of the valve causes
change in plate current, which can be
ad from the meter.

Due to the amplifying action of the
alve, such a circuit can be arranged to
easure voltages lower than those norm-
ly measured on the meter directly.
/hat is more important in many cases,

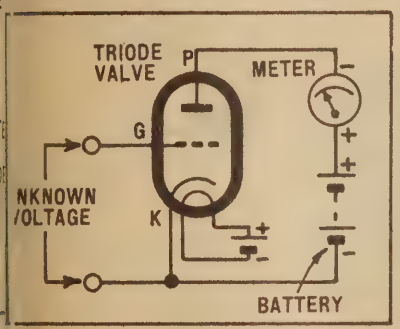



***Fig. 3. A triode valve with a meter in its plate circuit can be used as a simple voltmeter, having very high input impedance and increased sensitivity.***

ie very high input resistance means that
ie measuring circuit does not draw ap-
reciable current from the test circuit.
other words, it does not "load" it.

This circuit is quite practical, but is
ather limited in its scope. In the form
own it is really only suitable for mea-
uring small voltages and those which
an be connected with their negative
oint to the grid. This is not always a
onvenient requirement.

## TANDING CURRENT

In addition, when the bias is set to a
ot on the valve curve where linear
peration is achieved, there is quite an
ppreciable standing current, which
aturally reads on the meter. The result
that the actual usable portion of the
ale on the meter is reduced. This effect
an be removed, in turn, by using a spe-
al "bucking out" circuit, but the limi-
ations of the circuit are such as to make
generally impractical.

Alternatively, we can reduce the stand-
ng current to a minimum by biasing the
alve almost to cut-off, but this gives us
ore meter scale only at the expense of
nearity, which now becomes very poor
t the lower end of the scale.

However, a circuit has been developed
om this which is of some practical im-
ortance. This is the "Slide-back" volt-
eter, shown in Figure 4. In this circuit,
variable bias voltage from the battery
') and potentiometer (R) combination
used to cancel out the effect of the
known voltage.

This is how it works: Before the un-
own voltage is measured, the two in-
ut terminals are shorted together. The potentiometer R is used to provide a certain negative grid "bias" voltage by picking off a portion of the voltage drop in its total resistance due to the battery V.

This results in the valve passing a certain cathode-plate current, which is noted. (In practice, the bias is actually set so that the meter reads up to a mark on the scale.) The unknown voltage is then applied to the input terminals, whereupon the valve is either driven towards cut-off or full conduction, depending on the size and polarity of the voltage applied.

The grid bias potentiometer, which must be calibrated in terms of the actual voltage tapped off, is then manipulated until the meter returns to its previous reading. Since the bias voltage on the valve must now be the same as it was before, it follows that the amount by which the potentiometer voltage has had to be changed is equal to the unknown voltage.

Thus, by reading the change in potentiometer voltage, one can see the size and polarity of the unknown voltage. The instrument can be used to measure voltages over a wide range and of either polarity, by altering the size and polarity of the variable bias supply. The bias supply is merely a variable cancelling-out device.

## RATHER INCONVENIENT

Although quite versatile, this circuit is a bit "messy" in operation. What is needed is a circuit which will read the voltage without one having to "cancel out" or mentally add and subtract dial readings. There are a number of circuits which do in fact do this, one being the so-called "Balanced Bridge" circuit.

Before we introduce this particular circuit, a short discussion of the general bridge circuit may help in understanding its operation. Since the bridge circuit is quite fundamental, and has many very important applications in both electronics and industrial automatic control, the extra time will certainly not be wasted.

Figure 5 shows the basic bridge circuit, as it is used to measure an unknown resistance Rx. Figure 5 (a) is the circuit as it is usually shown in books, while (b) is the same circuit re-drawn in a slightly different manner. Sometimes even drawing a circuit a different way can help one to understand its operation!

Now let us consider just the left-hand leg of the circuit, ignoring the right-hand leg and the meter for the time being. A current I1 will flow through the two series resistors Rx and R3 and across each there will be a certain voltage drop. The potential of the point A

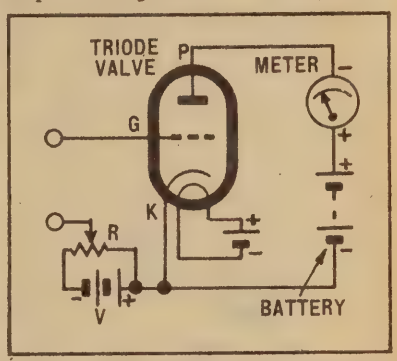



***Fig. 4. The "Slide-Back" voltmeter is a more versatile and convenient form of the simple voltmeter shown in figure 3.***

with repect to point C will thus be the voltage drop across R3, which according to Ohm's Law is I1 times R3.

Since, according to Ohm's Law also, I1 is equal to V divided by the total resistance of the leg, it equals V divided by (Rx plus R3).

These two facts allow us to express the voltage drop across R3 in terms of V and the two resistances. Thus the potential of A with respect to C is equal to V times the ratio of R3 to (R3 plus Rx). Obviously, this is going to be less than V, since we are multiplying V by a number less than one. This explains why two resistors in series across a battery constitute a "voltage divider."

Note carefully that the actual value of the potential of A is only dependent on the ratio of R3 to (R3 plus Rx), and thus indirectly on the ratio of R3 to Rx. As long as the ratio remains fixed, the potential at A is the same. Two small value resistors in a certain ratio give a certain voltage at A, and two big resistors in the same ratio give the same voltage. The leg currents are not the same, but the voltage drops remain constant.

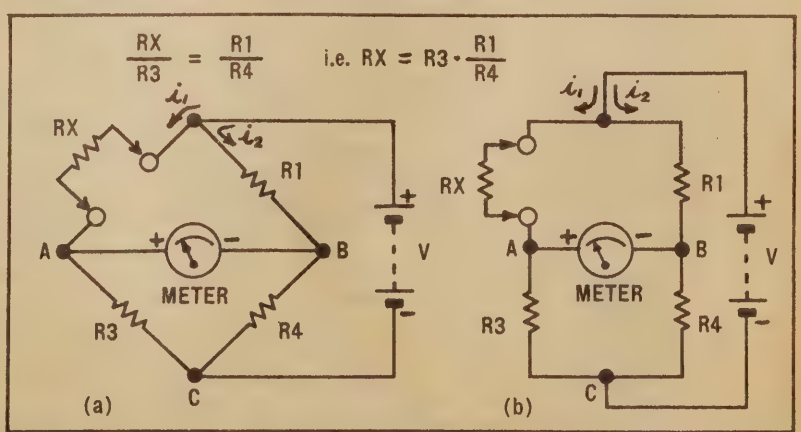



***Fig. 5. The bridge circuit may be drawn in two ways. Shown here is the simplest bridge circuit, the D.C. or "Wheatstone" Bridge (named after its discoverer). The bridge is said to be balanced or "nulled" when the meter reads zero. This will be when the points A and B are both at the same potential with respect to C.***

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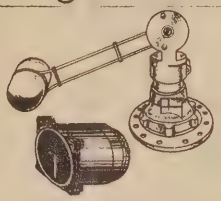

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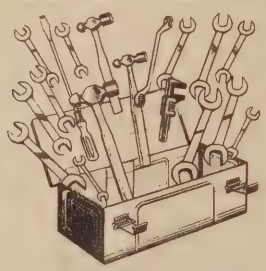

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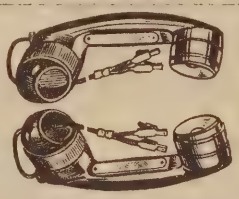

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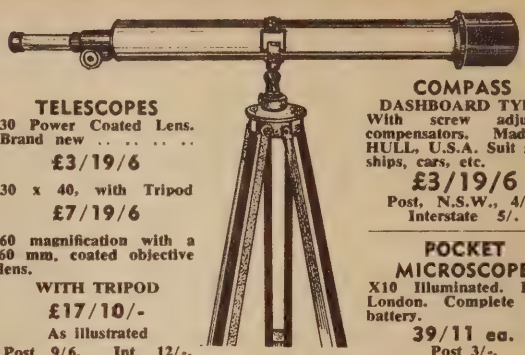

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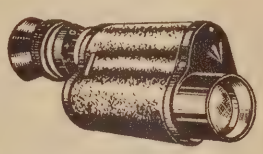

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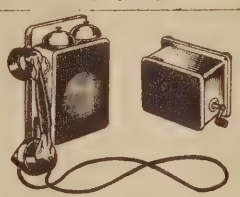

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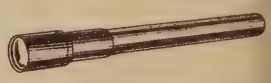

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Think of it this way: Two small value esistors result in a relatively large leg urrent, but due to their small resistance, heir voltage drops are only small. On he other hand, large value resistors will nly cause a small leg current, but still ave the same voltage drops as they have nore resistance. If the ratio remains onstant, so does the voltage division.

As you can see, the right-hand leg of he bridge is also a voltage divider, and hus the potential of the point B is pro-ortional to the ratio of R4 to R1 or, nore exactly, R4 to (R4 plus R1). This eads us to the actual operation of the ridge.

The meter connected between points A and B will naturally give a reading

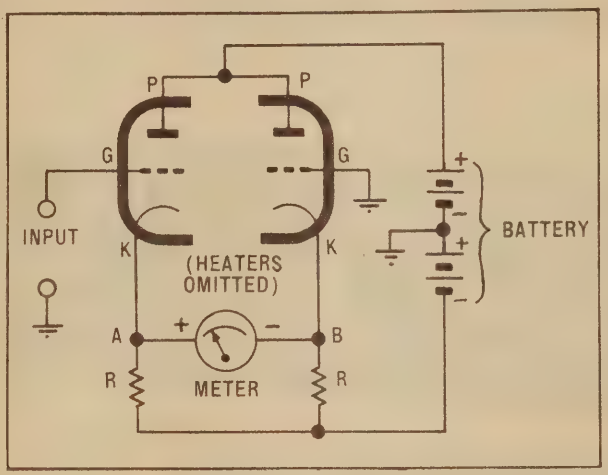


*Fig. 6. The balanced bridge electronic voltmeter, shown here in its basic form may be imagined as a form of the D.C. bridge shown in figure 5.*

there is any difference in potential etween the two points. The only way o obtain zero reading on the meter is o place A and B at the same potential. his can only happen if the voltage ivision ratio of the two legs is the me, since both are connected to the me voltage V.

Thus the bridge can be thought of a "ratio comparer." It is said to be hulled" or "balanced" when the meter ading is zero, or in other words, when e ratio of R3 to Rx is the same as at of R4 to R1.

We can find the value of Rx if we ow the value of R1, R3 and R4. Simply, x is equal to R3 times the ratio of 1 to R4—that is (R1 divided by R4).

The procedure when measuring an un-own resistor Rx is thus to manipulate e other three resistors until the meter dicates balance, and then to use the ree values to calculate Rx using the ove ratio. (In a practical bridge no lculation is necessary, the various re-tors being calibrated in such a way at the value may be read directly.)

## ANY USES

This basic bridge circuit has many es and applications — resistance easurement is only one. As an example, nsider the case where the bridge is rmally balanced, and one resistor, say , is replaced by a unit whose resist-ce varies linearly with temperature sort of idealised thermistor). The mount of unbalance of the bridge, and nce the meter reading, will depend on temperature, and thus the circuit n be used as a thermometer.

If a relay is put in the circuit in place a meter, the circuit becomes a thermo-t, and the relay can be used to con-l, for instance, the motor of a re-frigerator or the gas flow of a boiler.

However, the particular application of the bridge circuit which interests us at the moment is the one used in many electronic voltmeters.

The basic circuit for this type of voltmeter is shown in Figure 6. Two identical triode valves (usually in the same glass envelope, as shown here and called a "double triode") are connected across a battery. Each is connected in series with a resistor R, both resistors being equal. These may be likened to R3 and R4 (fig. 5), while the two triodes are replacements for R1 and Rx.

One of the triode grids is earthed, and the other is connected to one input terminal, the other being earthed. If the input terminals are shorted together, we can see that both triodes are operating under exactly the same conditions. They should thus both draw exactly the same current.

The voltage drops in the two resistors should be identical, and the meter, which is between the two cathodes, will read zero, because points A and B will be at the same potential. (This is a special case of the bridge circuit, where not only are the leg ratios the same, but the actual values are as well.)

If, however, a small positive voltage is applied to the live (meaning not earthed) input terminal, the left-hand triode will draw more current than the other one, whose grid is earthed. The increased current will also flow through the left-hand resistor, increasing its voltage drop. Thus point A will become more positive than B (which has remained as it was) and the meter will read.

If the valves have a linear grid voltage-plate current characteristic, in other words if their transfer characteristic is a straight line, the meter reading will be directly proportional to the input voltage, and the scale can be calibrated merely by using a suitable multiplying constant.

## SET BY RESISTOR

It is usual to put a variable resistor in series with the meter, and to adjust it until the new meter sensitivity makes the constant a convenient number, such as 3, 5 or 10.

Naturally, this circuit is rather limited in its range of inputs. It can only measure voltages which are sufficiently small neither to drive the input valve to cut-off, nor send its grid positive (which stops its controlling action). In practice, this range of voltages is quite small, particularly as we must stay on a portion of the transfer curve which is linear.

This, and a number of other faults, make this simple basic circuit rather impractical. Various modifications are necessary to make it a practical instrument. Next month we will discuss a number of these modified circuits, including the automatic electronic voltmeter, and also mention the amplifier-type AC voltmeter.


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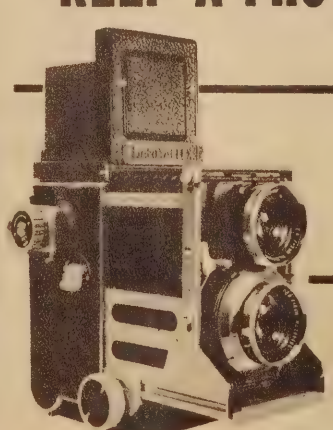

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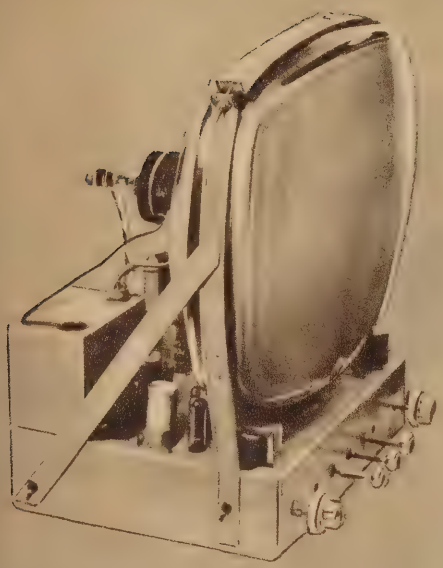

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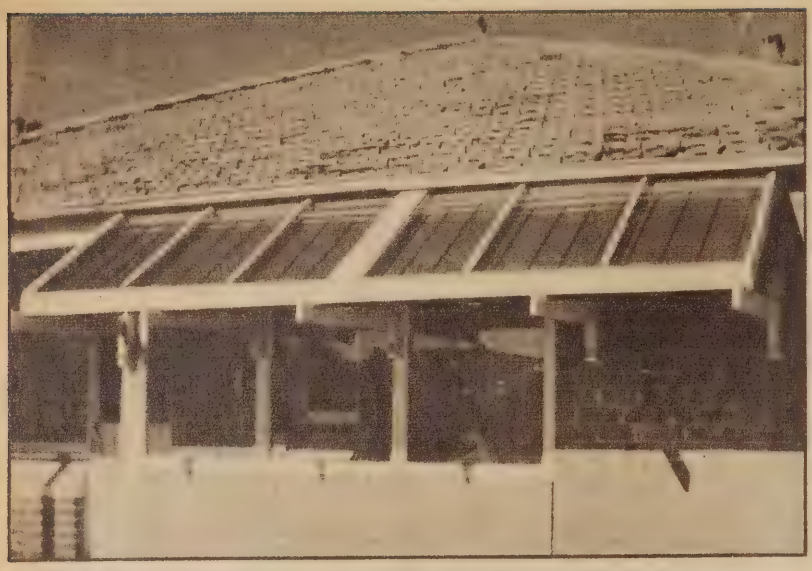

*The author's absorber, mounted so as to form a useful awning for a back verandah. The two units are shown mounted end to end, each measuring approximately 3ft by 6ft. The copper tubes joining the head and bottom pipes are clearly visible behind the glass screens. Note also the method of supporting the complete assembly.*

# The Solar Heater—How To Build It

**Following last month's theoretical discussion on solar heaters, we now present the more practical side—what are suitable "sizes" for a typical household, materials required, and details of the actual construction. Most of the work is well within the scope of tools and skill possessed by the average handyman.**

**By Reg Johnson**

THE unit to be described may fairly be described as "typical," being used in an average suburban home to serve an average family. However, for those who may want something a good deal larger or who may be forced to use something smaller, a brief resume of the performance figures arrived at by various authorities, will make a very useful guide.

## A GOOD GUIDE

Average hot water consumption per day varies with the number of people in the household, and a good guide is about 10 gallons per person per day. Thus, in a household of four people, a 60-gallon storage tank (a popular size) should give about one and a half days' supply.

Approximately one square foot of absorber will be needed for every gallon required per day and, on this basis, an area of approximately 36 square feet should suffice. However, these are only approximations, and some variation is possible without seriously upsetting performance.

For convenience, this area is spread over two separate absorber box assemblies, one of which can be connected to the tank to provide some service while the other is being built. A pair of such units is shown in the picture of the author's own installation at the head of this article.

Coming to the actual construction, the first material we will need is copper pipe. For each box we will need two 7ft lengths of 1in O.D., and about 38ft of ½in O.D. Fig. 1a shows details of how these should be cut and drilled.

The two 7ft lengths of 1in O.D. form the head and bottom tubes of the unit. Commencing 3in from one end, mark out 12 points at 6in intervals and drill a half-inch hole at each point. This leaves the last foot of tubing clear for connection into the system.

Next cut 12 lengths of ½in O.D. pi each 36½in. These are to be insert in the ½in holes already drilled in t head and bottom pipes and, in ord that the flow of water through the latter will not be restricted in any w the ends should be shaped as shown Fig. 1a. This shaping is best done wi a ½in round file.

When all the tubes are cut and shap they are to be assembled into a n work as shown in Fig. 1b. To hold ever thing together initially it will be nec sary to provide some form of jig clam and, in addition, it is a good idea refrain from dressing the ½in holes the head and bottom pipes so that t smaller pipes will be a push fit.

## DETAILS OF JIG

The next job is to braze these join A few constructors may have the mea to do this themselves, but most will ne to have the job done professionally. E gineering shops, panel beaters, garag etc., should be able to supply this s vice, and an approximate cost would 1/ per joint.

However, it will be necessary to ha everything firmly assembled before su mitting the job for brazing and son details of the jig used by the author w help the home constructor to ma something similar.

For the first part, obtain two lengt of timber, say 2in x 2in, and a lit over 6ft long. Lay one underneath t assembly, parallel with the head a bottom pipes, and about midway b tween them. Mark out the position each short pipe by running a pen down each side, then remove and ma a saw cut for each pencil mark. Wh the waste material is chiselled out the will be a series of channels into whi the pipes will fit.

If care is taken in spacing the sa cuts, the pipes will be a push fit, whi the depth of the cut should be slight less than the tube diameter. This pie of timber is placed underneath the a sembly, with the pipes in place, and t second piece laid on top and the tw nailed together in three or four places

## PREVENT WARP

This will hold the smaller pipe leaving only the head and bottom pip to be secured. Timber spacers are c and fitted between the jig just describe and these pipes, using at least three pair one in the centre and one at each en Finally, to ensure that the pipes will n warp while being brazed, at least thr loops of stout wire are slipped over t assembly and tightened by twisting wi a stick. Held in this manner, the enti assembly may be transported a handled without risk of movement un the brazing job is complete.

It would be possible to avoid t brazing process by using capillary f tings throughout. However, the co would be very high, and a lot more f ting and cutting would be necessary.

With the tubing assembled, the next ep is to solder a 6ft x 3ft sheet of 24- uge copper to one side of the sembly, lining one edge up with the orter ends as shown in figure 2. This b must not be skimped, as the efficiency the unit depends on the efficiency of e thermal bond between the copper ate and the tubing.

There are two ways to tackle the job. ne is to tin the copper tubes on one de, then the copper sheet in vertical nds to match the tubes, finally bring- g the two together and applying the at from a blowlamp. During this lat- r operation sufficient pressure must be plied to ensure that the two items are rought into intimate contact.

## ECOND METHOD

The second method is to lay the tube sembly on top of the copper sheet, itably supported on a flat surface, and ply flux (Bakers' fluid), heat, and lder in that order. Regardless of the ethod used, it is essential that nple heat be applied and the solder is mpletely fluid, not merely soft or sty. It is really too large a job for one rson, and a second pair of hands is most essential.

The finished assembly is given a coat flat black paint to ensure that it ab- rbs the maximum amount of heat.

Essential dimensions and general con- ruction of an absorber box is shown in g. 3. It is made from 5in x 1in tim- r, and divided into four compart- ents, the dividers being removable ngths of 3in x 1in timber, held in ¼in cesses along the sides of the frame. ach compartment should measure 17¼in 42in, and the dividers should fit flush ith the top of the frame.

Each compartment thus formed is to fitted with two sheets of glass separ- ed by approximately one inch, with the wer sheet about one inch above the sorber assembly. Fig. 4a shows how e glass supports are fitted, the scale ing deliberately exaggerated in the in- terests of clarity.

## OTTOM REINFORCED

The bottom of the box is made from ro cement or Masonite (or similar aterials), first nailed directly to the ame, and then reinforced with at least ree 3in x 1in battens on the under- de, screwed securely into the frame. ee Fig. 4b.)

At this stage the absorber box should mounted on its final position, and the correct angle for the locality. (See ble.) Make sure that whatever means used to support it is sufficiently strong carry the total weight of the box, ab- rber assembly, insulation, etc.

A typical "awning style" installation is own in the picture at the head of this ge, and the supports for it are clearly sible. They are made from 5in x 1in rdwood, mortised into 3in x 2in ocks, which are in turn fastened to isting wooden uprights or brick wall. his is shown in greater detail on page .

Alternatively, upright supports could provided, but care should be taken see that they do not present a hazard dark nights if they encroach on nor- al yard space.

With the box in position, the bottom

# FIRST STAGE OF THE ABSORBER

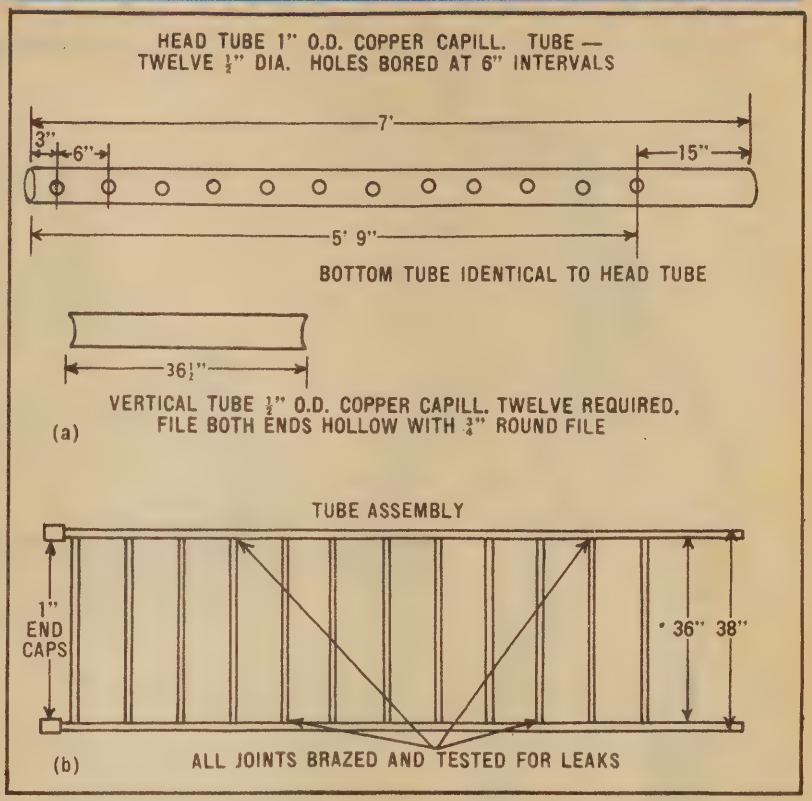
HEAD TUBE 1" O.D. COPPER CAPILL. TUBE — TWELVE ½" DIA. HOLES BORED AT 6" INTERVALS
7'
3"
6"
15"
5' 9"
BOTTOM TUBE IDENTICAL TO HEAD TUBE
36½"
VERTICAL TUBE ½" O.D. COPPER CAPILL. TWELVE REQUIRED. FILE BOTH ENDS HOLLOW WITH ¾" ROUND FILE
(a)
TUBE ASSEMBLY
1" END CAPS
36" 38"
(b)
ALL JOINTS BRAZED AND TESTED FOR LEAKS

***Fig. 1. This shows (a) the details of the head and bottom pipes, plus the shorter connecting pipes. Note the shaping of the latter. At (b) is the complete tube assembly as it will be after brazing.***

is covered with slabs of rock-wool insulation to a depth of 2in and the absorber plate fitted on top of this. When the exact position of the plate is known, two holes should be bored in the end of the box to allow the longer ends of the head and bottom tubes to protrude.

The three removable divider struts may now be fitted, less the upper glass support pieces, and secured permanently with 3in wood screws. Four pieces of glass are now required, each 17¼in x 41¼in, and in 18oz weight. These are simply rested on the lower support pieces without puttying.

The upper glass supports may now be fitted, followed by the outer glass screens. These are cut to the same dimensions as the lower sheets, but from 24oz weight. These must be well puttied to ensure a really watertight joint,

## MATERIAL LIST

**4 6' 3" lengths 5" x 1" Oregon . . . Head and bottom members**
**4 3' 8" lengths 5" x 1" Oregon . . . End members**
**6 3' 7" lengths 3" x 1" Oregon . . . Box divisions**
**4 3' 8" lengths 3" x 1" Hardwood . . . Anti-sag supports for wallboard**
**32 3' 6" lengths ⅜" x ⅜" Softwood . . . Glass rests**
**16 1' 5" lengths ⅜" x ⅜" Softwood . . . Glass rests**
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**4 doz 3" C. S. Head wood screws**
**1lb ¾" wallboard nails**
**½lb 1" panel pins**
**2 sheets 7' x 4" Burnie Board**
**36 2" Rockwool Bats 14" x 12"**
**2 sheets 24 S.W.G. copper**
**76' ½" O.D. capillary copper tube**
**28' 1" O. D. capillary copper tube**
**Length 1" O.D. capillary copper tube for flow and return pipes**
**8 Sheets 17¼ x 41¾ 18oz clear glass**
**8 Sheets 17¼ x 41¾ 24oz clear glass**
**7lbs non hardening waterproof putty**
**1qt Blackboard paint (or other oil based flat black)**
**1qt Paint primer**
**1qt gloss enamel (interior white, exterior to suit)**
**6 sticks 50/50 solder**
**4 1" capillary end caps**
**2 1" x 1" x 1" capillary tees**
**Soldering fluid or paste**

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d special non-hardening black putty recommended for the job. Finally, ve the whole woodwork several coats paint, finishing with a gloss enamel.

If, when in operation, the inside of e glass is subject to fogging in the rly mornings, it is most probable that e puttying is at fault, allowing moisre to enter. This, and other possible ints of entry, should be thoroughly ecked.

Even though a single absorber box presents only half the total area reired, it may be put into operation imediately on the basis that it will conbute something to the system while e second unit is being built. The cond box is identical with the first in ery way, except that the protruding ds of the head and bottom tubes face the opposite direction, i.e., so that ey will meet those of the first ox when the two are placed end to d.

The two units are coupled by means 1in x 1in x 1in capillary "T" pieces d, when the flow and return pipes are led, the whole combination fused in e usual way.

## EXT—THE TANK

The next point to consider is the tank. it is part of a system already in operion it will be necessary to determine nether it has the necessary fittings to ke the flow and return pipes and, if t, whether these can be fitted.

If a new tank is to be fitted anyway, should be specified as having fittings r a solar unit or fuel stove. These e normally fitted at only a small extra st.

**However, we would most strongly advise the handyman not to try building his own tank. Many allowances have to be made for expansion, etc., the booster element and thermostat have to be fitted correctly and, all in all, it is a job for someone with plenty of experience.**

Tanks are normally fitted inside the of space, although it is possible to ect one outside the roof on a special ind should this be necessary. Naturly, it must have adequate height in gard to both the taps it is to serve d the absorber, as discussed last onth. Also, it will need special protion from the weather, and it would wise to seek the manufacturer's ade in this regard.

If you intend to install the tank yourf, first survey the roof space and deterne the best location. Points to conder are (1) ability to get the tank into the space with a minimum disturbance of the roof and other parts of the building, (2) the need to have a dividing wall under the tank since, when full, a typical tank will weigh around 1,000lb, and (3) the desirability of providing the shortest possible runs to sinks and wash basins.

A platform must be provided for the tank, and this should have a reasonably level surface. Cypress pine flooring is a handy material, supported either directly on the ceiling joists, or on a separate frame made from 4in x 2in hardwood.

## OVERFLOW TRAY

**With any hot water tank it is essential to provide an overflow tray. This is to protect the building from serious damage which would otherwise occur in the event of a failure of, say, the ball cock, and the resultant continuous flow of water on to the ceiling.**

Trays are available commercially, and at a price which makes it hardly worth while to make one. When installed they should be fitted with an overflow drain of 2in or 3in downpipe, run to a convenient outlet point under the eaves.

## DETAILS OF THE ABSORBER BOX

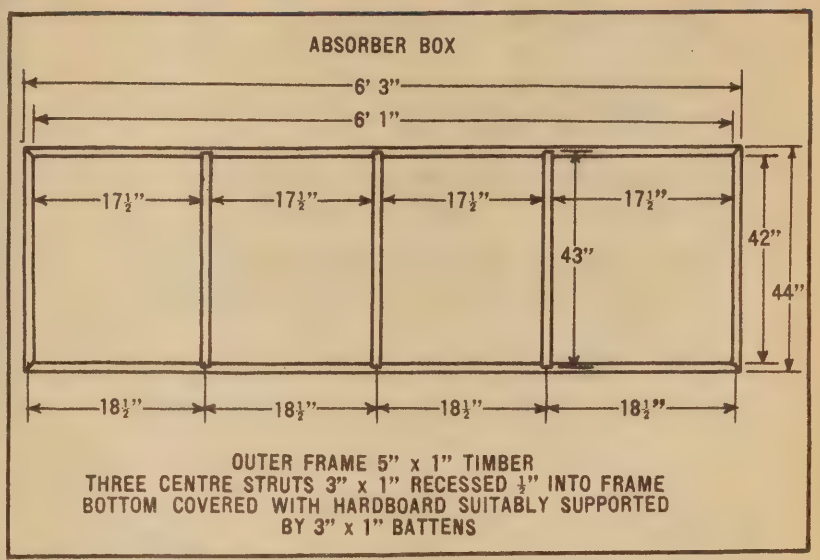


*Fig. 3. The absorber box is built around a wooden frame of 5in by 1in timber. The divider sections both strengthen the box and serve as supports for the glass screens. They fit flush with the top of the frame.*

## Absorber Angles

The CSIR Organisation in Melbourne have carried out extensive tests, and as a result have issued the following table. It gives correct angles of inclination to the horizontal for best operation of solar collectors. Apart from being at the correct inclination, the collector must point as nearly due north as possible.

| | Deg. |
|---|---|
| Darwin | 17 |
| Cairns, Broome | 22 |
| Rockhampton, Alice Springs | 28 |
| Brisbane, Geraldton | 37 |
| Broken Hill, Perth | 37 |
| Sydney | 39 |
| Canberra, Adelaide | 40 |
| Melbourne | 43 |
| Hobart | 48 |

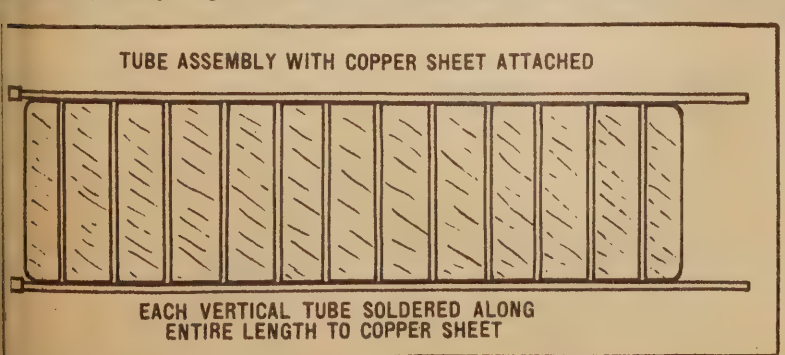


*Fig. 2. After the network of tubes has been assembled and brazed it is soldered to a sheet of copper which functions as an absorber plate. A good bond to the plate is essential to ensure maximum transfer of heat.*

Before removing the roofing material make sure there is sufficient space between the purlins and the ceiling joists to allow the tank to be pushed through. If no problem exists, remove the roofing from two or three rafters and cut these at 45 degree angles at the top and bottom, allowing just enough clearance for the tank. Replace the rafters and roofing material immediately the tank has been installed. The cut rafters may be strengthened by joining with steel plates or pieces of 4in x 2in timber bolted over the joins.

The actual manhandling of a tank into the roof will call for some preparation. Two men can lift such a tank easily enough, particularly if it is securely roped, but whether they will be able to manoeuvre it into position depends to a large extent on the type of roof and the nature of the footholds available. If in doubt, it is better to have a few too many hands than too few.

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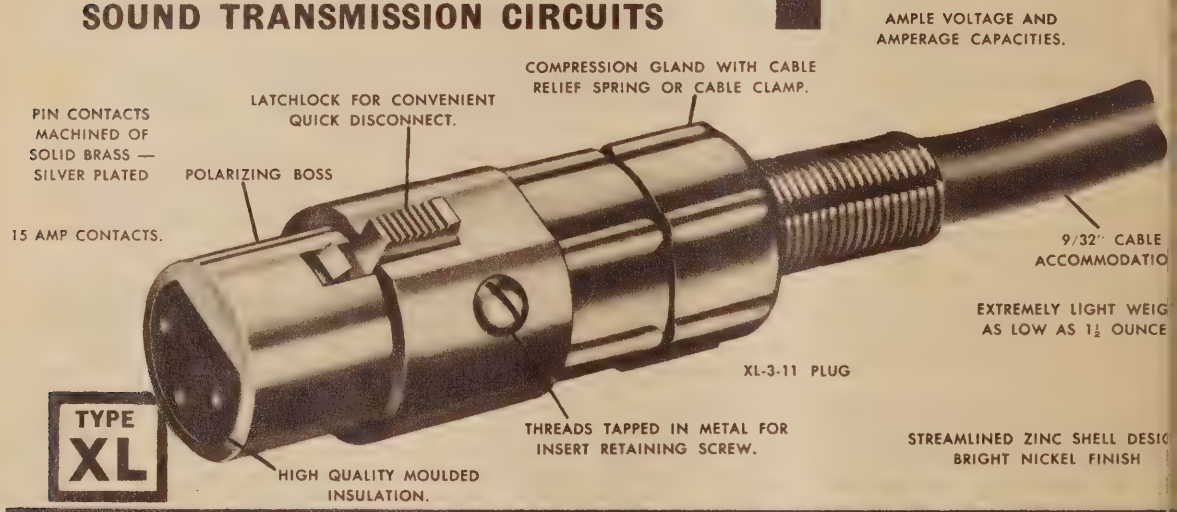
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POLARIZING BOSS
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AS LOW AS 1½ OUNCE
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TYPE XL
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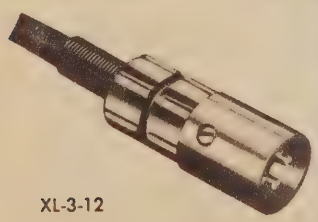
STREAMLINED ZINC SHELL DESIG
BRIGHT NICKEL FINISH
HIGH QUALITY MOULDED INSULATION.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ater line may be connected to the stern (a job for the plumber), the hot- ater lines to the outlet, and the flow d return pipes from the absorber into e appropriate fittings. Then the tank, d the absorber, may be filled with cold ater.

**Some care is needed in this operation to avoid damage to the absorber. An empty absorber which has been exposed to the sun will get very hot—much hotter than the boiling point of water. If water is suddenly introduced into such a system large quantities of steam will be generated and, if this cannot escape fast enough, may cause serious damage. Night or early morning is a good time for this job and, if there is any heat in the absorber at all, the water should be introduced slowly.**

A most important point is the insula- n of the flow and return pipes, other- se a substantial proportion of the heat ptured from the sun will be wasted fore it reaches the tank. At least one ch of good quality insulation is re- ired, and strips of rockwool bound with double sided aluminium foil ll do a good job. Where the pipes are posed to weather, extra protection and terproofing should be provided.

## ETTER INSULATION

A better type of insulation takes the rm of ready-made half-round sections compressed rockwool or similar aterial. Available in convenient lengths, is simply fitted to the pipe with simple etal straps and has the dual advantage being a good deal easier to fit than lk material and also of doing a better . Various insulation firms would be le to advise on cost and other details.

Another question to be considered is fitting of a solar absorber to an isting hot water tank. Assuming that suitable place can be found for the sorber, relative to the tank, the main oblem is that of providing entry points the flow and return pipes, which ust be at the top and bottom of the nk respectively.

This will probably entail cutting a all panel from the galvanised iron ter casing (say 6in x 6in), then re- oving the insulation until the copper nk is reached. Naturally, the system l have to be drained, then a suitable le drilled in the tank to take the re-

*A close up portion of the absorber box, showing details of the supporting arm protruding from the building. This arrangement avoids the use of additional supporting posts.*

# THE FINAL ASSEMBLY DETAILS

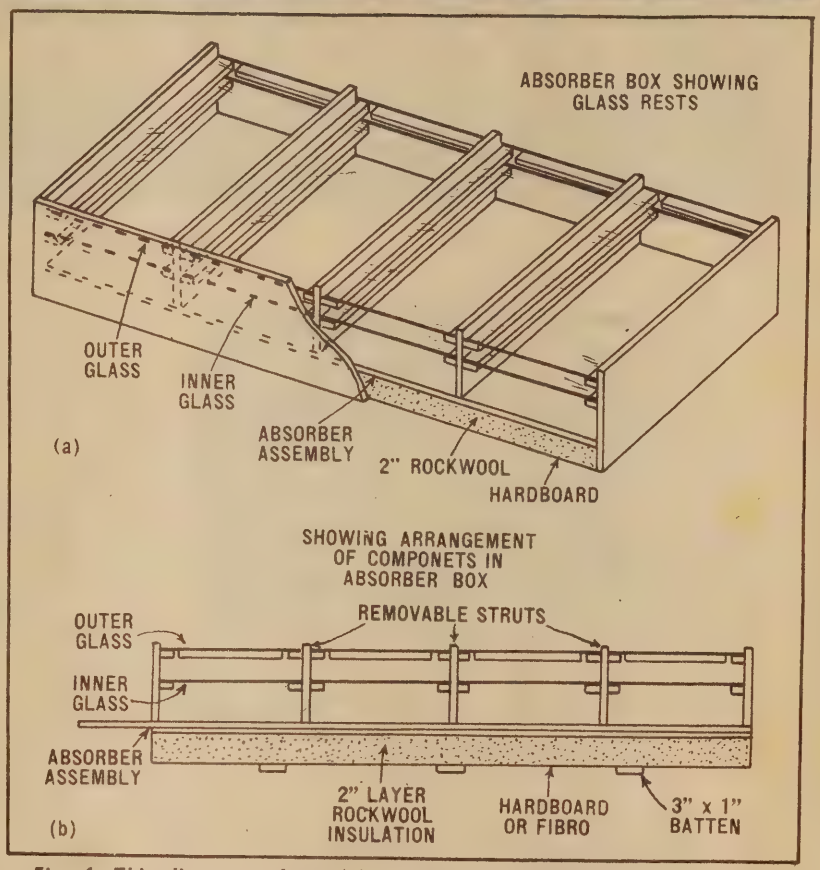


***Fig. 4. This diagram shows (a) a somewhat exaggerated picture of the glass supports on the divider sections and the manner of fitting the glass screens. At (b) is a side elevation showing the relative position of the screens, absorber, insulation, etc.***

quired fitting. This may be soldered in position, but would be better brazed, particularly as the fitting itself will have to be soldered to subsequently, which could complicate matters. It would be as well to seek the advice of a plumber in a case like this, unless you are quite sure of what you are doing.

There is also the further question as to whether the tank is a "displacement" type, or a "falling level" type. In the former, hot water is taken from the top of the tank and cold water introduced at the bottom, care being taken to see that turbulence is kept to a minimum and that the hot and cold water does not mix.

In the falling level type, hot water is taken from the bottom of the tank and a solenoid operated valve prevents cold water entering the tank until power is applied to the heating element.

Considering the displacement type, it would appear feasible to use the hot water outlet for the flow pipe connection and, possibly, the cold water inlet for the return pipe. Alternatively, either one or two new fittings would have to be added to accommodate these pipes separately.

In the case of the falling level type, the hot water outlet could be used for the return pipe, and a new fitting added to take the flow pipe. In addition, it would be necessary to convert it to "dis-


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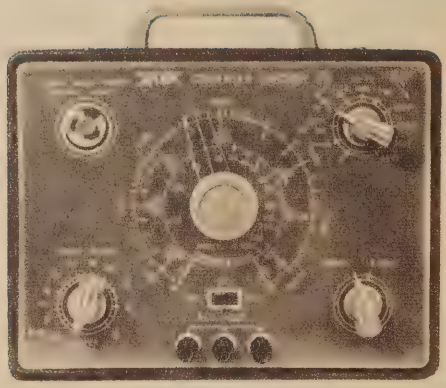
# BASIC TEST INSTRUMENTS



## *T.M.K.* Model L.C. 15

**Resistance/Capacity Bridge**

**Price: £17-10-0 plus 12½% tax**

Ranges: Capacity:
0.00001 *u*F to 0.005 *u*F
0.001 *u*F to 0.5 *u*F
0.1 *u*F to 1000 *u*F

Resistance:
R range 100 ohms to 50K ohms.
R by 100 range 10K ohms to 5 megohms

Leakage:
Voltages of condensers to be tested 25, 150, 250, 350, 450V.

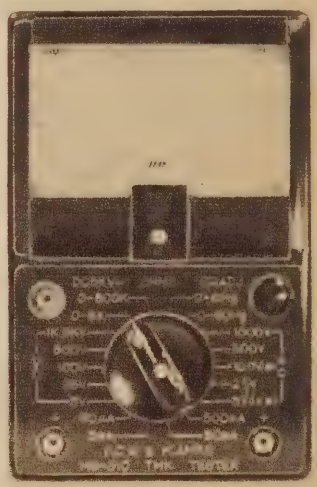
Power Factor Test

## *T.M.K.* Model M.G. 310

**Price: £9 plus 12½% tax**

**20 KV Probe £3/15/0 plus 12½% tax.**

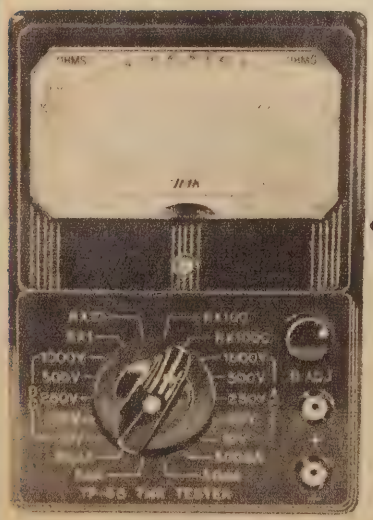
DC Voltages:
0-5-25-100-500-1,000-5,000V (20,000 ohms/V)
AC Voltages:
0-5-25-100-500-1,000V (10,000 ohms/V)
DC Current: 0-50 *u*A, 0-5-50-500 mA.
Resistance: 0-6K-600K, 0-6 Meg-60 Meg
(30 ohms, 3K, 30K, 440K at centre scale)
Capacitance: 100*u*uF-0.01*u*F, 0.002*u*F-0.3*u*F
Inductance: 20H to 2,000H
Decibels: —20db to plus 30db in 2 ranges



## *T.M.K.* Model T.P. 5S

**Price: £6-13-6 plus 12½% tax**

**20 KV HV Probe £3/15/0 plus tax.**



DC Voltages:
0-10-50-250-500-1,000V (20 Ohms/V)
AC Voltages:
0-10-50-250-500-1,000V (10,000 Ohms/V)
DC Current:
0-50 *u*A, 0-5-50-500 mA
Resistance:
0-10-100K, 0-1-10 Meg
(62 ohms, 620 ohms, 6.2K, 62K at centre scale)
Capacitance:
0.0001*u*F-0.005*u*F
0.005*u*F-0.1*u*F
Decibels:
—20db to plus 36db in 2 ranges

**With Full Guarantee Service and Spare Parts From:**

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# The FERROCART Model P.V.33

***A completely new V.T.V.M. FOR ONLY £19-10-0***

***Plus 12½% tax***

**The Ferrocart features exclusive internal switching of the 1 megohm resistor to give all A.C. Volts, D.C. Volts and Ohms without changing probes (except accessory E.H.T. and Germanium probes). The meter movement has Dynamic Breaking in the "off" position for Safe Transport of the P.V.33.**

**R.F. Probe, R.F. 22 (Germanium) £2/5/0 plus 12½% tax**

**H.V. Probe, H.V. 20 (20 k.Volt) £3/0/0 plus 12½% tax.**

***SPECIFICATIONS:***

## DC RANGES

| | | |
|---|---|---|
| 0—1.5 | Volt | Negative |
| 0—1.5 | Volt | Positive |
| 0—5 | Volt | Negative |
| 0—5 | Volt | Positive |
| 0—15 | Volt | Negative |
| 0—15 | Volt | Positive |
| 0—50 | Volt | Negative |
| 0—50 | Volt | Positive |
| 0—150 | Volt | Negative |
| 0—150 | Volt | Positive |
| 0—500 | Volt | Negative |
| 0—500 | Volt | Positive |
| 0—1500 | Volt | Negative |
| 0—1500 | Volt | Positive |

**RESISTANCE**
From 0.02 to 1000 megohm in seven ranges.

## AC RANGES

| | | |
|---|---|---|
| 0—1.5 | Volts | A.C R.M.S. |
| 0—4 | Volts | A.C P-P |
| 0—5 | Volts | A.C R.M.S. |
| 0—14 | Volts | A.C P-P |
| 0—15 | Volts | A.C R.M.S. |
| 0—40 | Volts | A.C P-P |
| 0—50 | Volts | A.C R.M.S. |
| 0—140 | Volts | A.C P-P |
| 0—150 | Volts | A.C R.M.S. |
| 0—400 | Volts | A.C P-P |
| 0—500 | Volts | A.C R.M.S. |
| 0—1400 | Volts | A.C P-P |
| 0—1500 | Volts | A.C R.M.S. |
| 0—4000 | Volts | A.C P-P |

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| PL-2 Standard | Acetate | 3" | 200 ft. | 11.4 |
| AC-3 Long-Playing | Cellulose Acetate | 3" | 300 ft. | 13.4 |
| PL-6 Standard | Acetate | 5" | 600 ft. | 1. 9.6 |
| AC-9 Long-Playing | Cellulose Acetate | 5" | 900 ft. | 2. 0.0 |
| PL-12 Standard | Acetate | 7" | 1,200 ft. | 2.15.0 |
| AC-18 Long-Playing | Cellulose Acetate | 7" | 1,800 ft. | 3.14.3 |
| PL-24 Standard | Acetate | 10½" | 2,400 ft. | 5.14.0 |
| AC-36 Long-Playing | Cellulose Acetate | 10½" | 3,600 ft. | 7. 3.0 |

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cement" type operation. This may rmally be done by simply loosening couplings on the solenoid valve, turn- this upside down, and tightening the uplings again. The valve will now erate by gravity and remain open even en disconnected from the power.

Results can be expected within a uple of hours of putting the absorber o operation assuming a sunny day, or ittle longer on a cloudy day. A rea- nably good layout should raise the nperature above 160 degrees on a ar summer day, and to between 120 d 150 in winter sunshine.

Once the system is working correctly, ne consideration must be given to the nperature at which the thermostat is to cut out, the requirements for a ar heater being somewhat different m those of a conventional system.

## HERMOSTAT SETTINGS

Normal practice with off peak systems to set the thermostat around 160 de- es. This is a good compromise be- en efficiency (i.e., minimising radia- n loss, etc.) and the desire to store a sonable amount of heat during the ht and ensure an adequate supply ring the day. Fairly obviously, the her the temperature the greater the ective amount of hot water available, ce more cold water may be added. However, this is less important with olar heater, since the water is being ted during the day while it is being d. And, of course, it also will be sted again at night if this is neces- y.

What is important is to see that the nperature is not raised so high during night that there is little or no con- tion during the day, at least until water is used and cold water intro- ced. Thus, in the extreme case of tank being heated overnight to 180 190 degrees, there would be little or heat transferred from the absorber ess it could exceed this temperature, ich is unlikely with normal efficiency.

Thus, most heat is transferred when the tank temperature is kept moderately low, and a figure of 135 degrees is suggested by most authorities as a good compromise. It is much too hot to use directly and, provided there is an ample supply, there is very little need for it to be any hotter. On the other hand, this is a minimum figure affecting only the electrical system, and there is nothing to prevent higher temperatures being achieved by the solar unit on most days.

A further point is that, considering that most of the water used will cost nothing at all, there is no longer the same incentive to take advantage of the reduced rates provided by off-peak operations. Rather, on the few occasions when the weather is consistently bad, power at normal rates may be used for boosting during the day.

Since household requirement may vary, the individual will have to make his own decision on this matter, but this should not be hard if the foregoing points are appreciated. Briefly, it is simply a matter of setting the system for the lowest possible figure consistent with an adequate supply at an adequate temperature under, say, typical winter conditions.

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Model 201—Minipex.

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# MONTHLY NEWSLETTER

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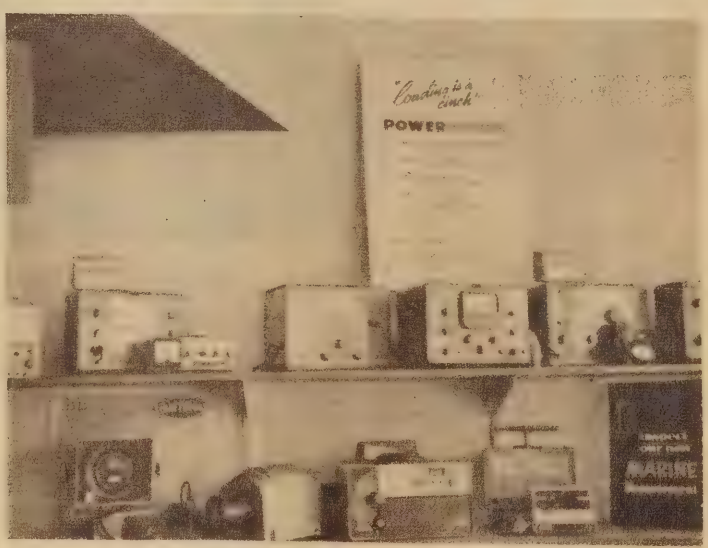


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# A READER BUILT IT!

**Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.**

# TV TUNER ADAPTED TO RECEIVE FM TRANSMITTER

**Suggested by Mr W. J. Rafter, of 25 Willandra Street, Alderley, Brisbane, a simple attachment to the R, TV and H television tuner and receiver will allow it to receive the FM stations operated by the ABC in Sydney, Melbourne, Brisbane and Adelaide.**

SOME modifications were made simultaneously to the original tuner design but these are not really necessary for the reception of FM signals.

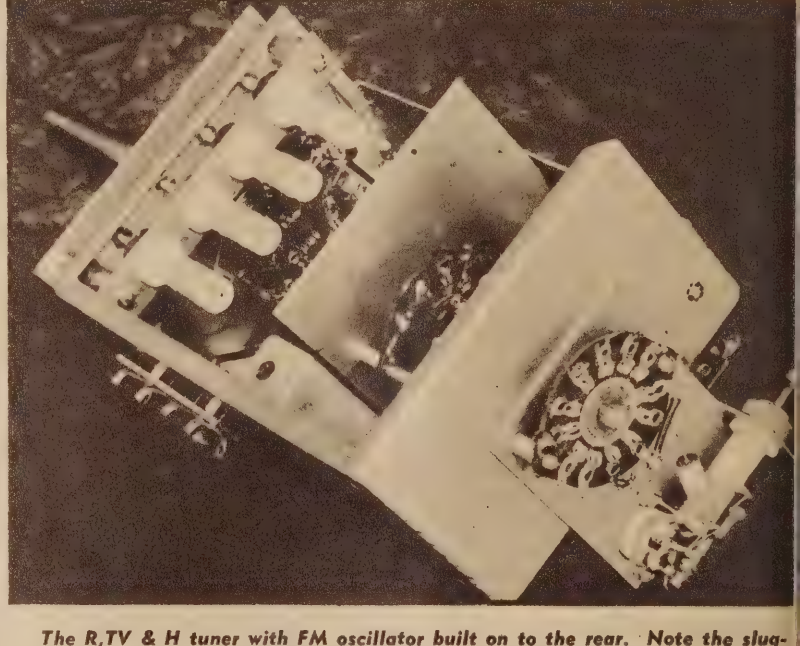
The main aim of the modifications was to simplify the tuning of the local oscillator. Instead of the air-wound coils in the orginal tuner, threaded, ceramic, slug-tuned coils out of the BC733D "Approach Receiver" were substituted.

They were mounted so that the slug adjusting screws protruded from the front of the tuner. This gave a much finer and more convenient adjustment than the original idea of "knifing" the coils.

## EXTRA CHANNEL

The tuner was modified for four channels and, as the aerial and RF coils are incremental, the sequence of switching had to be Channel 2, ABC FM, Channel 7 and Channel 9.

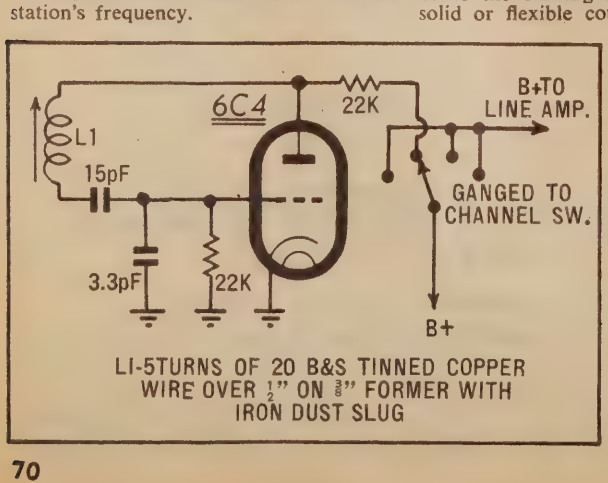
Television stations transmit two carriers, one for picture and one for sound, 5.5 Mc apart. The two IF resultants beat together to produce a 5.5 Mc signal which passes through the receiver's intercarrier IF channel. To receive the FM station which, of course, has only one carrier, it is necessary to provide a "second carrier" 5.5 Mc below the FM station's frequency.



*The R,TV & H tuner with FM oscillator built on to the rear. Note the slug-tuned coils for the local oscillator and extra shielding between RF and mixer circuits, which the constructor said he found to be desirable.*

This extra carrier can be provided by adding a triode oscillator, which is switched on in the FM position and off in the TV positions.

The switching is done with an extra switch bank added to the rear of the tuner and operated by an extra length of control shaft. This latter can be attached to the existing shaft by means of a solid or flexible coupler.




☆

*Circuit details of the 6C4 oscillator. Any similar miniature triode or triode-connected pentode would probably serve as well.*

☆

An added refinement to the switchi circuit cuts B-plus to the line amplifie so that you can listen to the FM statio without having a raster on the pictu tube screen. (Beware of excessive H voltage with reduced load.—Editor.)

If you have a commercial tuner, wi no facility for adding an extra switc bank, the receiver can still be modifi along the lines suggested but the switc ing function will have to be carried o by a control additional to the norm channel selector.

## NOT CRITICAL

It is not absolutely necessary to co the modifications exactly as shown the illustration, since it is only necessa to supply a small amount of "extra ca rier" and the oscillator can really l located in any spare space on the r ceiver's chassis.

The switch has no RF function, that it can be located well away fro the oscillator and—as indicated—on t rear of the channel selector switch.

The suggested oscillator uses a 6C which is readily available either new through disposals.

The coil in this oscillator is also o

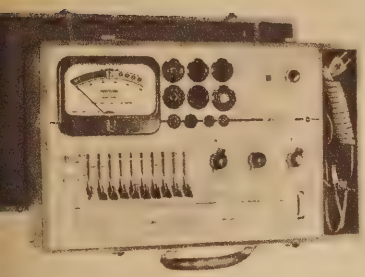
**(Continued on Page 75)**

PACE

# *PRECISION* TUBE & TRANSISTOR TESTERS

Industrial • Laboratory • Communications • Radio • TV (Monochrome and Color) • Education

## Model 640 CATHODE CONDUCTANCE TUBE TESTER



Gives the ultimate degree of value in a tube-checking instrument designed according to time-proven emission-testing principles, as have been recommended by tube manufacturers and EIA.

The Model 640 provides the highest degree of insurance against obsolescence PLUS the utmost simplicity and speed of operation. Ideal for tube sales counters, field service and test bench.

The Model 640 gives all this, and at such modest price, without the slightest sacrifice in the long established *PRECISION* standards of workmanship, quality and reliability.

- **Free-point 10-lever element selector system** for merit, leakage and short tests of all tubes.
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- **Filament voltages from ¾ to 117 volts** on 24-position rotary selector switch.
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- **Individual tests for each section of multi-section tubes** and ballast resistor-type tubes.
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- **Free Tube Test Data Subscription Service** to all registered owners, for one full year!

**Model 640:** With etched, satin-brushed aluminum panel. Leatherette-covered, solidly constructed carrying case with tool compartment and hinged, removable cover. Case dimensions: 18 x 10½ x 6¼ inches.

**AUST. PRICE: £59/11/- + S.T.**

**ALSO AVAILABLE:** Model PTA Picture Tube Adapter Cable and Model PAA 110° picture tube socket adapter. See details elsewhere on this page.

## Model PTA

### PICTURE TUBE ADAPTER CABLE

For use with all present *PRECISION* tube checkers listed in this catalog. Also for use with previous *PRECISION* tube checkers, Models 612, 614, 620, 654, 910, 912, 914, 915, 920, 922, 954, 10-12, 10-15, 10-20, 10-22 and 10-54.

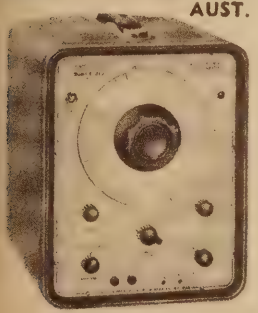
**AUST. PRICE: £5/7/9 + S.T.**

## Model PAA

### 110° DUAL SOCKET ADAPTER

Permits the PTA Picture Tube Cable to be used for testing both base systems of 110° deflection type picture tubes.

**AUST. PRICE: £3/6/10 + S.T.**



## Model E-310

### WIDE-RANGE SINE and SQUARE WAVE GENERATOR

**...el E-310 is the only generator on the market today ...h offers both sine and square wave coverage of ...subsonic, audio, supersonic and lower RF spectra ... moderate price. Its outstanding stability and re...lity make it an ideal addition to the modern ...tronic laboratory.**

**...xtra-Wide Frequency Range:** Sine and square waves 5 cycles to 600 kc in 5 decimal bands. ± 1% direct reading accuracy (or 1 cycle).

**...utput Characteristics:** Within ± 1 db over each ...and, and within ± 1 db band to band.

**...istortion:** Less than 1% from 5 cps to 600 kc.

**...evel:** Sine wave, 10 volts r.m.s. into 600 ohms.
Square wave, 10 volts P-P, 0.15 μsec rise time.
Four position step attenuator and continuous amplitude control.

**...leter...g Terminals** are provided at front panel for ...onvenient monitoring of output level via use of ...cternal VTVM, V-O-M or VU meter.

**... Diameter Tuning Dial** — With 12 to 1 drive ratio. ...rovides scale length of 85" over the 5 bands.

**...ompactly Dimensioned — Light Weight** — Ruggedly ...onstructed for long, dependable service.

**...l E-310:** In heavy-gauge, custom-styled, louvred case with fine dull blue-grey ripple finish. Brushed aluminum panel and spun aluminum tuning dial. Dimensions 9 x 11½ x 11¼ inches.

**...UST. PRICE: £114/5/- + S.T.**

## Model SS-10

### SERIES-STRING FILAMENT CHECKER

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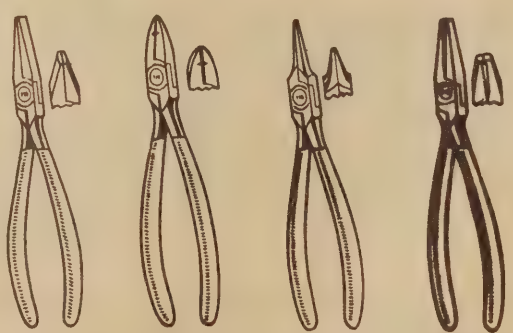
**AUST. PRICE: £6/15/- + S.T.**

## CHANNEL LOCK

## ELECTRONICS PLIERS



No. 718 FLAT-NOSE PLIER

No. 728 DIAGONAL CUTTER

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# *PRECISION* OSCILLOSCOPES

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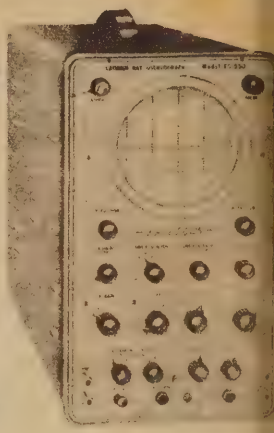
## Model ES-550 B

**WIDE-BAND, HIGH-SENSITIVITY 5" SCOPE** Response 10 cycles to 5 megacycles.

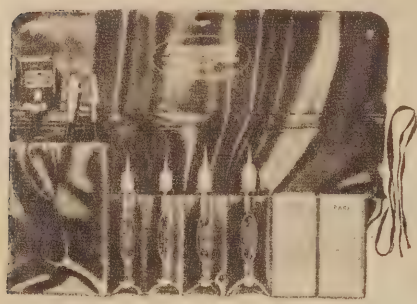
The Model ES-550 is the *PRECISION* answer to laboratory, industrial and electronic technician's requirements for a rugged, dependable instrument for broad coverage of modern electronic oscillograph applications, **INCLUDING COLOR TV.** The ES-550 provides an unparalleled standard of extra-high sensitivity with full wide-band frequency response, plus many other special performance features, at a most sensible selling price.



- **Push-Pull, Wide-Band Vertical Amplifier:** 10 MV (.01 volts) per inch sensitivity. Cathode Follower Input: 2 Megs. and 22 mmf. Response 1 DB from 10 cps. to 3.5 Mc; 3 DB at 5 Mc.
- **3 Position Vertical Step Attenuator:** Frequency compensated. X100, X10, X1.
- **Direct Reading, Peak to Peak Voltage Calibrator**—permits use of 'scope as dependable, high impedance VTVM.
- **Vertical Pattern Reversing Switch.**
- **Push-Pull, Wide-Range Horizontal Amplifier:** 100 MV (.1 volts) per inch sensitivity. Cathode Follower Input: 2 Megohms and 22 mmf. Response 1 DB from 10 cps to 1.0 Mc and 3 DB at 2 Mc.
- **3 Position Horizontal Step Attenuator:** Frequency compensated. X100, X10, X1.
- **Linear, Multi-vibrator Sweep Circuit:** 10 cycles to 100 Kc. Automatically synchronized 30 cycles and 7875 cycles sweep for TV sync-pulse analysis. Amplified sweep retrace blanking.
- **Amplified Auto-Synch. Circuit:** active on all internal sweep ranges.
- **Four-Way Synch. Selection:** Internal Negative, Internal Positive, External and Line.
- **3000 Volt Intensifier Anode Potential** assures utmost visibility of 'scope traces for pulsed waveforms and high frequencies.
- **"Z" Axis Input Terminal** for blanking, timing and marking.
- **Built-in 60 cps Phasing and Blanking Controls.**
- **All 4 Deflection Plates Available** with full beam centering.
- **Tube Complement:**
  12AV7 Vertical Cathode Follower and Amplifier.
  6U8 Vertical Amplifier and Phase Splitter.
  Two 6CL6 Push-Pull Vertical Drivers.
  6U8 Horizontal Cathode-Follower and Amplifier.
  6C4 Horizontal Phase Splitter.
  12BH7 Push-Pull Horizontal Driver.
  12AV7 Wide-Range Linear-Sweep Multi-vibrator.
  6BH6 Auto-Sync Amplifier.
  12AU7 Sweep Retrace Blanking Amplifier.
  0A2 Voltage Regulator.
  5V4 Low Voltage Rectifier.
  Two 1V2 High Voltage Rectifier.
  5CP1/A Cathode Ray Tube.
- **High Contrast, Filter Type, Removable Calibrating Screen.**

**Model ES-550** (illustrated in custom-styled, blue-gray ripple finished, heavy gauge steel cabinet. 2 color satin-brushed aluminum panel. 8¼" x 14½" x 18½". Complete with all tubes and comprehensive Technical Manual.

**AUST. PRICE: £161/10/- + S.T.**



## Model SP-5

**OSCILLOSCOPE TEST PROBE SET**

**for General Waveform Analysis, TV Signal Tracing, Alignment and Trouble-Shooting**

The SP-5 probes significantly enhance the ease and accuracy with which the oscillograph can be applied to sensitive electronic circuits and to the analysis of complex waveforms.

This set of 4 matched probes is engineered for use with all previous and current *PRECISION* Cathode Ray Oscillographs, Models ES-500, ES-500A, ES-520 and ES-550.

**The set includes:**

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2. CRYSTAL — DEMODULATING PROBE
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- These 4 probes and Shielded Master Cable are conveniently packed in a custom-made vinyl carrying case.

**Model SP-5:** Complete as described, with detailed operating instructions.

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The Model 660 is the only moderately priced instrument which gives you comprehensive $I_{CBO}$, gain, leakage, shorts, etc. tests on every type of transistor, as well as standard cathode conductance tube testing facilities and picture tube beam current tests.

- **Provides every tube testing feature of the Model 640 described above.**
- **Comprehensive transistor testing features**—designed on the basis of engineering recommendations of leading transistor manufacturers. Tests $I_{CBO}$, gain, shorts and leakage on all RF, audio, power and tetrode transistors—both N-P-N and P-N-P types.
- **Tests crystal diodes** in special circuit, for both forward and reverse current.
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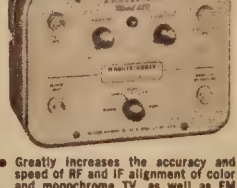

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**The Model 220 Marker-Adder is a "must" for the thoroughly equipped, efficient service shop or laboratory that prides itself on the accuracy and speed of its work and insists on getting the greatest benefit out of its basic test instruments.**

**The Model 220 can be used with most all existing alignment instruments.**

- Greatly increases the accuracy and speed of RF and IF alignment of color and monochrome TV, as well as FM receivers.
- Improves the accuracy and versatility of the conventional sweep generator, signal-marker generator and 'scope.
- Permits use of large-size, highly visible markers, without distorting the sweep response curve.
- Eliminates the need to connect the marker signal generator to the tuned circuits of the receiver.
- Makes the marker pip fully visible in traps and at other zero response points.
- Prevents marker signal from overloading the receiver tuned circuits . . . preserves the true shape of the sweep response curve.

**Model 220:** in attractive, rugged, blue-grey, ripple-finished steel cabinet. Size: 5⅞" x 7¾" x 3½". Complete with 4 connecting cables and technical manual.

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matchless mirror smooth surface tape
An exclusive **irish** development

The *ferro-sheen* process offers *five* major benefits over conventional magnetic tapes

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**2. MINIMUM HEAD WEAR.** The mirror smooth surface of **irish** tape reduces head wear considerably below that of ordinary rough surface tapes.

**3. FREEDOM FROM HEAD CONTAMINATION.** **irish** tape has the most homogeneously bonded oxide of any magnetic tape. NO external lubricant is needed as ample lubricant is built into the oxide. This right combination of the right ingredients reduces oxide and lubricant build-up on heads to an absolute minimum.

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**5. MINIMUM DROP-OUTS.** The remarkable *ferro-sheen* process produces a superior tape with maximum freedom from drop-outs.

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### 211
### GREEN BAND
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The only premium-quality high-fidelity tape at the standard price. "*Ferro-sheen* processed" 1½-mil acetate. Meets the highest professional standards and all EIA and NAB specifications. Compatible with existing standard bias settings. Superior frequency response characteristics.

| Length (feet) | Reel Size |
|---|---|
| 150 | 3" |
| 300 | 4" |
| 600 | 5" or 5¾" |
| 850 | 5¾" |
| 1200 | 7" |
| 2400 | 10½" |

### 601
### LONG PLAY
*(Mylar*)*

A premium-quality *ferro-sheen* process tape with 50% more playing time than standard tape on any given reel size. Made on 1-mil Mylar* polyester film base for longer storage life plus outstanding strength and tear resistance. Meets highest professional recording standards. Superior frequency response characteristics.

| Length (feet) | Reel Size |
|---|---|
| 225 | 3" |
| 450 | 4" |
| 900 | 5" or 5¾" |
| 1150 | 5¾" |
| 1800 | 7" |
| 3600 | 10½" |

### 195
### BROWN BAND
*(Acetate)*

Budget-priced "name brand" quality tape backed by the famous **irish** guarantee. 1½-mil cellulose acetate base. Frequency response characteristics superior to all other budget priced tapes. Guaranteed splice-free. Widely used in homes, schools, churches – wherever a good inexpensive tape is needed.

| Length (feet) | Reel Size |
|---|---|
| 600 | 5" or 5¾" |
| 850 | 5¾" |
| 1200 | 7" |

### 724
### DOUBLE PLAY
*(Tensilized Mylar*)*

Twice the length of standard tape. Twice the strength of conventional thin tapes. Made by the *ferro-sheen* process on specially strengthened ½-mil Mylar* base. Greatly increased tensile strength (6 lbs.) eliminates necessity for gentle handling. Superior frequency response.

| Length (feet) | Reel Size |
|---|---|
| 300 | 3" |
| 600 | 4" |
| 1200 | 5" or 5¾" |
| 1650 | 5¾" |
| 2400 | 7" |
| 4800 | 10½" |

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In too short a time, these musical experiences are over and gone. But if you make the **right preparations**, you can capture them to hear again whenever you want.

You record them on magnetic tape, of course. This is one of the fastest-growing hobbies in America today and it's easy to see why. You don't have to be a graduate engineer to make real hi-fi recordings. And you can record even with only an AM radio receiver and a tape recorder. Follow the few rules explained in this brochure and you will enjoy making up programs from your off-the-air material, edited into interesting sequences with your own announcements, to entertain your friends.

You will find great richness in musical programs taped off the air. Many tape fans will specialise, building up their tape library by recording only classical music . . . others may prefer a library of popular music or "Hit Parade" songs . . . some will specialise in calypso . . . still others might prefer marches or patriotic music, jazz or bebop.

And a good number of hobbyists build up tape libraries of "mood music," by recording individual selections, until they have a full tape of "Dinner Music" "Dance Music," "Gay Music," or "Relaxing Music."

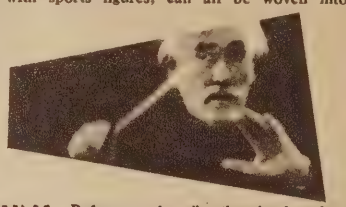
● **A businessman** might wish to record talks by business analysts or important political speeches. An **attorney** may find it helpful to record Congressional Hearings or detailed news accounts of current trials.

● **A clergyman** may record outstanding sermons which are broadcast on Radio or TV, helpful talks, different religious services, hymns, or religious dramas.

● **Parents** can tape children's shows such as "Captain Kangaroo," "Howdy Doody" or "Rin Tin Tin," for playback on rainy days. Outstanding programs like "Peter Pan" can be saved for years and replayed many times. Those programs which are broadcast late in the evening can be recorded and played back during daylight hours.

● **Sports fan?** You have a wonderful, wide field of recording. Historic contests—championship games—the entire season of your favourite team—interviews with sports figures, can all be woven into programs to make your big moments stay alive.

● **For the serious student** of literature, music, or drama, there are few study aids superior to an off-the-air recording of a modern play, a Greek drama, an opera, a piece of classical music, or one of Shakespeare's immortal works. Interesting passages can be played over and over as many times as may be necessary to obtain a clear understanding. Great operatic arias can be studied in detail. Questions about actors' lines or the proper treatment of a given scene can be rechecked as often as is needed.



## WARNING—OFF-THE-AIR RECORDING IS STRICTLY FOR FUN!

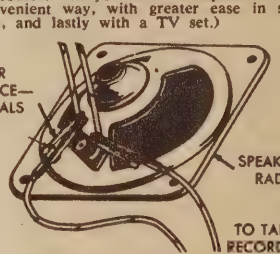
Before we describe the simple rules for making off-the-air recordings, we must issue an important warning. Toss overboard any smart notions you may have about selling copies of your recordings. Invite your friends in to hear your own Menuhin—that's fine. But don't try to sell the recordings, or charge admission to hear them—it is strictly illegal. Your off-the-air recordings are strictly for your enjoyment.

## WHAT YOU NEED TO MAKE RECORDINGS OF BROADCASTS

You can make good recordings with just two pieces of equipment: an FM or AM radio receiver (any size or model) or a TV set, and a tape recorder. An FM radio will provide better reception, of course. If you have a separate FM radio tuner feeding into a hi-fi system with a flexible preamp-control unit, you can do the job in a more convenient way, with greater ease in stopping, starting, etc. (We will describe the procedure with the radio receiver first, then with the tuner-hi-fi system, and lastly with a TV set.)

## RECORDING FROM A RADIO RECEIVER

To get the radio signal (electrical impulse) into your tape machine make (or get your radio repairman to make for you) a length of lamp cord with a plug on one end that fits the jack on your tape machine, and two alligator clips on the other end. Fasten the clips on the voice-coil terminals of your radio loudspeaker without changing the radio wiring in any way. (See figure number 1.) Plug the other end into your tape recorder and you are ready to go. You have a "low impedance" line from radio to tape machine, and you can listen to the radio as usual while recording is going on. (Warning: To avoid a possible danger of shock with **AC-DC sets**, make sure that the radio power plug is inserted in the wall outlet with the prongs in the "ground" position. A "polarised" plug does this automatically. If you are not **absolutely** sure of what you are doing, ask your radio man for instructions.)




## GET THE VOLUME RIGHT!

With any recording on magnetic tape the most crucial difference between a bad recording and a dandy is **the strength of signal you apply to the tape** (assuming that radio and tape machine are both operating properly).

If the electronic impulse you put on the tape is too strong you will overload the tape and produce a harsh or fuzzy sound, full of distortion. If the signal is too weak, the softer passages will be lost in the noise which is always present in any sound reproduction system; this also makes for unpleasant listening. For the best results, the loudest passages of the music should be just below the level that causes unpleasant distortion.

## HOW TO SET THE VOLUME LEVEL

When you use a voice-coil clip-on connection to your tape machine, you have two controls for the volume: the volume dial on the radio, and the volume control on the tape recorder. You can get the same degree of loudness on the tape with a large number of control settings, by turning one up while you turn the other down. It is best to have both controls turned up at least part of the way. Don't turn the radio way up and the recorder way down, or vice versa.

## YOU MUST LEARN TO USE YOUR VOLUME INDICATOR

You determine the loudness of the signal you are applying to the tape by watching the "volume indicator" on your tape machine. The indicator may be of several types. The single neon bulb type barely flashes on the loudest peaks of sound (when the loudest phrases of the music are just below the distortion level). The "electron eye" has a pie-shaped shadow that just closes on the peaks for the same just-below-distortion setting. Most accurate and convenient of all is the "VU meter" used on the more expensive tape machines. The needle of the meter swings up on the peaks of sound, and you can set the volume so that the top swings just reach the "zero" level.

Before attempting to make recordings of music that you hope will have something like hi-fi quality, practise test runs at different volume levels, getting to know how the volume indicator reacts. Learn to correlate the indicator with the quality of the music you get on the tape.

## YOU NEED A WARM-UP TO PREVENT A SLIP-UP

To be ready to capture Satchmo or Menuhin successfully, you need a warm-up period of at least 15 to 20 minutes in advance of the actual recording time. Tune in the station that will carry the program you want. Get your volume adjusted during the preceding program, and you will probably need only a minor readjustment when actual recording starts. Your tuner also has a chance to warm up, and if it is FM it will do its drifting before the crucial period.

Most important, make a test run to be sure everything is working properly. Record five minutes of the preceding program and play it back immediately. If you wait until Satchmo starts to blow his horn, and **then** find the tape is not rewinding properly, that dish of jive is lost for good.

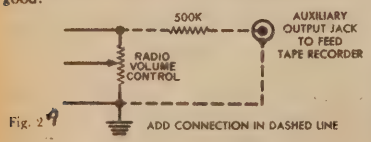
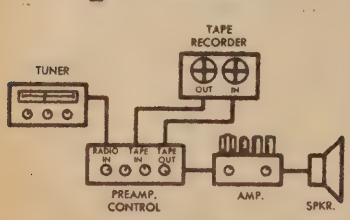


Fig. 2

## FOR BETTER FIDELITY, TAP OFF AHEAD OF OUTPUT STAGE

You get better fidelity by channelling the electronic impulse out of your radio somewhere ahead of the speaker. A good place to connect is across the high side of the volume control, as shown in figure number 2. Unless you are handy with a soldering iron and know the insides of electronic equipment, this connection should be made by a technician. A jack should be permanently installed, connected to the volume control as shown. You must now use shielded cable from radio to tape machine and not more than three to four feet of it, because the cable is at "high impedance." When you use this connection the radio volume control does **not** affect the volume of signal going into the tape machine. You can adjust your radio volume for best listening, and your tape recorder volume for best recording, without either one affecting the other.




## WITH A PREAMP-CONTROL UNIT, CONNECTION IS EASY

If you have a separate radio tuner feeding a hi-fi preamp-control unit, it is easy to connect in a tape recorder. Most modern control units have a "tape out" connection. At this connection you may pick up any signal that is passing through the control unit. Connect it by a shielded cable to the "high impedance" or "radio" input on your tape machine. The control unit will also have a "tape in" connection. Connect this to the "output" jack on your tape machine, as shown in figure number 3. This completes a head-to-toe arrangement, as shown in the picture.

Now you make an off-the-air recording and listen to it through the hi-fi system, just by throwing switches. Set the control selector to "radio," tune in the station you want in the regular way, and start the tape machine. To listen to the recording set the control selector to "Tape."

## START YOUR TAPE LIBRARY!

Now, don't you want to start your own library of unique audio events? Music is just one class of material. Historic speeches, once-in-a-lifetime news events, sports, great plays, and many other sound happenings add to the richness that radio and television are handing us every day. Put some of it on your shelf for keeps.

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of the BC733D. There is nothing unusual about the oscillator, though it is essential to keep the coil close to the 6C4 socket.

It was tuned to operate on 88.6 Mc for use with a 94.1 Mc FM station.

Formers in the BC733D have copper slugs in the threaded coils and iron-dust slugs in the unthreaded ones, which can be interchanged without much difficulty.

If you have any of these coils, use a threaded one with the iron-dust slug and five turns of number 20 B. and S. tinned copper wire for the 88.6 Mc oscillator.

If you use them also for your local oscillator, the following details will suit the tuner:

Channel 2: 6 turns of No. 20 B. and S. tinned copper, iron-dust slug.

ABC FM: 5 turns of No. 20 B. and S. tinned copper, iron-dust slug.

Channel 7: 5 turns of No. 20 B. and S. tinned copper, copper slug.

Channel 9: 4 turns of No. 20 B. and S. tinned copper, copper slug.

## ALIGNMENT

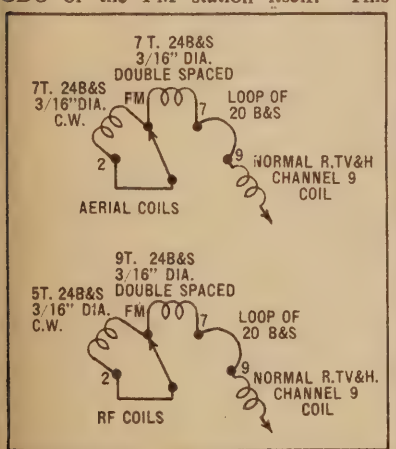
When you have completed the modifications, "tuning up" can be a problem unless tackled correctly. Some means of reading AGC voltage is really needed.

It is a big advantage also to have available a grid dip oscillator or signal generator with accurate calibration. A "hit-or-miss" approach will still secure results but it takes longer.

Set the signal generator or GDO on the FM station's frequency and couple it loosely to the input of the tuner. Even if you haven't changed your aerial and RF coils as yet, enough signals should get through the RF stage to permit adjustment of the oscillator coils.

Adjust the oscillator coil in the tuner for peak output indication, as observed across the video detector load or via the AGC line.

Now attach an aerial to the receiver and adjust the aerial and RF coils for peak output, either from the generator, GDO or the FM station itself. This




***Details of the Aerial and RF coils used by the author in his modified 4-channel tuner.***

will be purely an AGC function because, in the normal way, no sound will be available as yet from the intercarrier IF channel.

Now adjust the external oscillator slug until an audible signal is received from the FM station. If your GDO can be used as an absorption wavemeter, it can be used to help locate the external oscillator close to the requisite 5.5 Mc. below the FM station frequency.

If you don't have a signal generator or a GDO, try to locate the FM station by beginning with the tuner oscillator slug fully out, screwing it in until you get an indication of AGC voltage.

## OSCILLATOR ADJUSTMENT

Then adjust the 6C4 oscillator coil slug from fully out to fully in, until the signal is heard.

If you don't hear it, take the tuner oscillator slug further in, until you receive the next indication on your AGC line. Repeat the procedure with the 6C4 oscillator slug from fully out to fully in.

Continue this sequence of "tuning up" until the FM station is heard and identified, then adjust the aerial and RF coils for maximum signal.

The fine tuning control on the TV tuner should be set at about half capacitance during these adjustments and, when the FM station is located, you will find that the signal can be tuned in or out in about 15 degrees.

Thus, when switching from a TV channel to FM, don't forget to adjust the fine tuning carefully, because the FM station has only 150 Kc deviation, compared with the 7 Mc bandwidth of a TV station.

If you are using all five positions in the tuner, it will be necessary to experiment with the aerial and RF coils but data for the four-channel modification is given.

EDITOR'S NOTE: The quality of reception of an FM station is dependent on the accuracy with which its signal is centred on the "S" curve of the discriminator. This is all the more true in an adaptation of a TV receiver for the purpose, since the TV sound has less deviation than broadcast type FM.

## DRIFT PROBLEM

The extra oscillator must be adjusted very accurately and any subsequent drift could cause audible distortion on modulation peaks.

An alternative scheme is to set the extra oscillator on 30.5 Mc so that it will replace the original extra IF resultant. While oscillator drift is still important, this latter method allows it to be corrected by manipulation of the fine tuning control.

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# TRANSISTORS—WHY THEY AMPLIFY

**This is the second of a series of articles published by the Delco Radio Division of General Motors Corporation. Following last month's discussion on the atomic structure of germanium, this section deals with the practical behaviour of germanium, and the evolution of two and three element combinations with typical circuits.**

## PART TWO

TO understand the theory of operation of transistors, it is necessary to fully understand the hole movement theory, remembering that any time a hole moves in one direction, an electron will be moving in the opposite direction.

The hole current theory is very important in transistor theory.

The hole may be treated as a positive particle which acts just like an electron except that it has the opposite charge and therefore will travel in the opposite direction of an electron. One hole is created for every indium atom

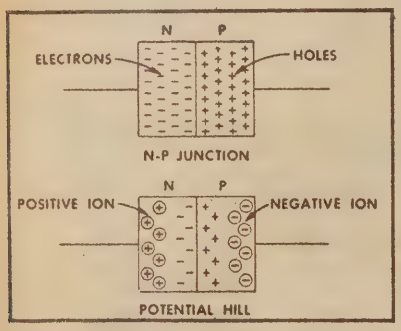



***Fig. 17. Disposition of hole and electrons with resultant fields in PN germanium junction.***

present and is considered to have the same mobility as an electron.

We have so far discussed two distinct types of germanium crystal, the N-type or donor material and the P-type or acceptor material. Figure 17 shows a piece of P-type material joined with a piece of N-type material.

Since the N-type material has an excess of electrons and the P-type has an excess of holes, positive current carriers, it would seem logical that, when these two materials are joined together, the excess electrons would flow through the junction and neutralise the excess of holes.

### JUNCTION BEHAVIOUR

There will indeed be a tendency for the electrons to congregate at the junction in the N-type material and likewise an attraction for the holes to congregate at the junction in the P-type material.

These current carriers will not completely neutralise themselves, however, since movement of electrons and holes cause negative and positive ions to be produced. This means an electric field is set up in each type material that will tend to obstruct the movement of current carriers through the junction.

The negative ions in the P-type material will repel the negative electrons in the N-type material and the positive ions in the N-type material will repel the positive holes in the P-type material.

This builds up what is called a potential hill and although very slight recombination at the junction does take place, this potential hill is soon built up to a point that no further recombination will take place without the application of an external difference of potential.

Now let's consider an N-P junction to which we do apply an external voltage.

In figure 18, we see that a small battery has been connected in series with an ammeter so as to apply a voltage to the two germanium crystals. You will notice that the positive electrode of the battery is connected to the N-type material and the negative electrode of the battery has been connected to the P-type material.

Since the N-type material has an excess of electrons, the positive voltage being applied to this material will attract these electrons toward the left end of the germanium crystal pellet.

The negative voltage being applied to the P-type material, which has an excess of positive current carrying holes, will attract these holes toward the right end of that pellet and away from the junction.

The ammeter indicates no current flow, since there is no possibility of recombination at the junction because the

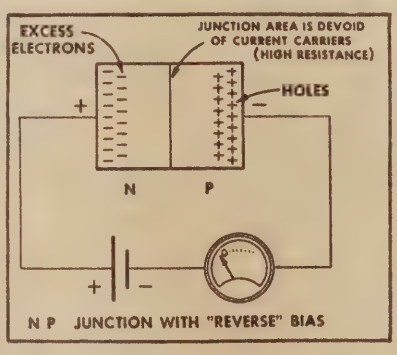



***Fig. 18. Effect of connecting a battery across a PN junction. With the polarity shown, no current will flow.***

potential hill has been built up to a higher value by the application of an external voltage. We call this the reversed biased condition or high resistance circuit.

You will notice that with this type of connection, the area around the junction is now a good insulator since few current carriers can be present.

We can connect the battery in the opposite polarity and cause a different condition.

In Figure 19, we have reversed the battery polarity and now the negative

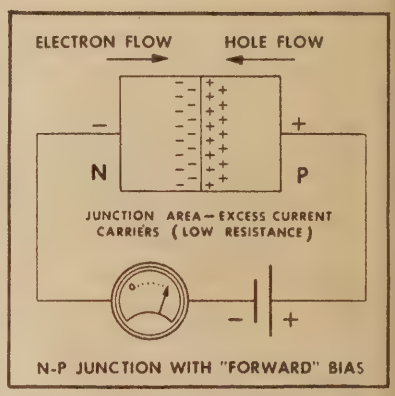



***Fig. 19. Similar to figure 18, but with battery polarity reversed. Current flow is now relatively high.***

electrode of the battery is connected to the N-type material. This negative voltage will repel the electrons in the N-type material toward the junction.

With this type of connection, recombination takes place at the junction resulting in current flow through the N-P junction as indicated by the reading of the ammeter. Since current carriers are plentiful in the junction area of the two materials, it now offers a low resistance to the flow of electric current.

### FORWARD BIAS

This method of attaching the battery is known as forward bias since it encourages current flow. It is important to remember that in this circuit, the electrons are flowing from left to right and the holes are effectively flowing from right to left.

Shown in Figure 20 are two germanium diode circuits. The one at Figure 20A has a low internal resistance because it contains a battery which is connected in the forward bias direction, placing current carriers on each side of the junction so that electric current can easily travel through the junction.

The low resistance of this circuit is represented as an equivalent resistor R shown in dashed lines. Notice that in Figure 20B the battery is connected so that the holes in the P-type material and the electrons in the N-type material are attracted away from the junction, leaving an insulating area on each side of the junction.

This is the reverse bias connection and results in an extremely high resistance as explained above. The resistance to the flow of battery current is now so great that it may be illustrated as an open resistor in comparison to the circuit in Figure 20A.

No appreciable current would now be able to flow through the load resistor R and there would, therefore, be no voltage drop produced across it.

From Figure 21, we see that we have onnected two pellets of N-type ger-nanium and one pellet of P-type ger-nanium in the form of a sandwich. The N-type material is the bread or bun of he sandwich and the P-type material is he meat.

The names emitter, base and collector ave been given to the three elements f the sandwich. We can see that the ollector circuit is open. The emitter is eturned to the base through a small attery and you will notice that this attery is connected so as to put the ase-emitter circuit in forward bias.

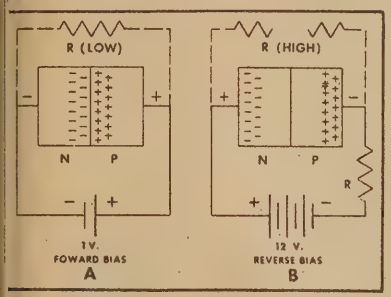



***Fig. 20. Behaviour of germanium diodes under conditions of opposite bias polarities, expressed in terms of resistance.***

The negative voltage at the emitter vill repel the electrons in that material oward the junction and the positive oltage at the P-type material base will n turn repel the holes toward that same unction. Recombination then takes place esulting in current flow, labelled 18.

We now have the forward bias con-lition or low resistance circuit in the mitter-base circuit.

Looking at the collector circuit, we ee that we have the positive electrode f the battery connected to the N-type naterial collector. The negative electrode f the battery is connected to the P-type ase when the switch is closed.

You will notice that this biases the ollector base circuit in the reverse bias ondition which, as we discussed before, vould not allow any current flow hrough the collector base circuit. Now, et's close the switch in the collector ircuit and see what takes place.

## COLLECTOR CURRENT

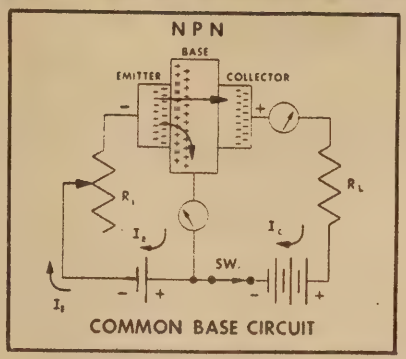
With the switch closed in the collec-or circuit (Fig. 22), we notice that we ow have some current flow in the col-ector circuit. This is true even though 'e have the collector base circuit biased n the reverse or high resistance direc-ion.

Let's see how we obtain this current ow. The negative voltage being applied o the emitter will set its electrons into notion. They will move toward the junc-ion and break through. Base material is elatively thin at that point and approxi-nately 95 per cent of the current car-iers will pass right on through and nter the collector circuit.

With the collector biased reverse, all f the electrons are attracted towards he positive pole of the battery. As elec-rons leave the emitter and pass into he base material, they come under the nfluence of this strong positive field and re accelerated into the collector.

As one electron enters the collector, it vill force another out of the collector hrough the load resistor and to the bat-ery, resulting in current flow.

# THE COMMON BASE AMPLIFIER



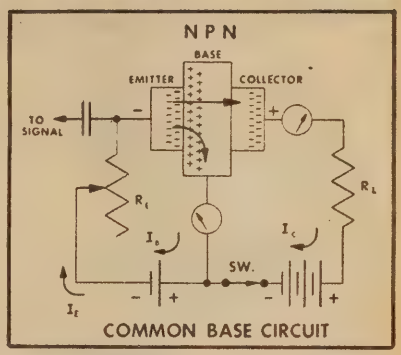




***Fig. 22 (left) shows behaviour of common base circuit with voltages applied to both collector and emitter. Fig. 23 (right) shows how the same circuit can be made to amplify when signal currents flow in the emitter/base circuit.***

As mentioned above, approximately 95 per cent or more of the electrons passing through the emitter base junction will enter the collector circuit. That leaves only 5 per cent or less of the electrons to recombine with positive holes in the base material which will constitute our base current.

You might say at this point that all we have really accomplished is to create a device which will result in current loss. This is true since the emitter current will always be greater than the collector current in this instance.

However, let's look at it in another

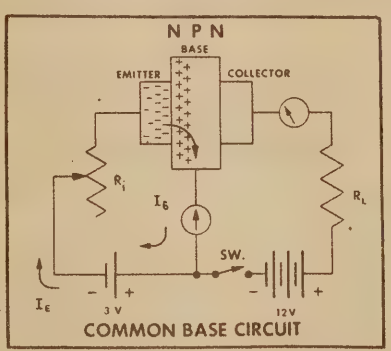



***Fig. 21. Three pieces of germanium—two N type and one P type — connected together to form an NPN type transistor. Note the name of each piece.***

way. The emitter-base circuit, which would be the input circuit in this case, is biased in the forward direction, resulting in a low resistance circuit. The collector is biased in a reverse direction, which results in a high resistance circuit.

You will notice that the collector current will be only slightly smaller than the emitter current but with the difference that the collector current is flowing through a much higher resistance circuit than in the emitter. This will result in voltage gains developed across the load resister RL, or amplification.

We now have a complete transistor and we can see where the device gets its name. The input circuit is a low resistance circuit; therefore, we have a transfer from low to high resistance or a transistor. We call this type of circuit a common base circuit since the base is common to both the input and the output.

Let's put a signal voltage into this circuit and trace the electron flow to see what takes place.

Looking at Figure 23, we see that a coupling capacitator has been added, which is used to couple the signal into the emitter base circuit. A potentiometer, RE, has also been added to the base emitter circuit. This potentiometer can be adjusted for the right amount of forward bias on the emitter base circuit.

In other words, this potentiometer will be adjusted so that, under static conditions, we will have a certain amount of current flow in the emitter base circuit. This will also result in some collector current. Let's trace the electrons through this circuit under static conditions.

The electrons will leave the emitter and travel through the junction into the base material, at which time five per cent or less of these electrons will combine with holes in the base and result in base current as indicated by IB.

Ninety-five per cent or more of the electrons will pass on through the base material due to their high velocity and the strong positive field at the collector base junction and will enter the collector resulting in the flow of collector current as indicated by IC.

All of these circuits are indicated as electron flow.

In Figure 24, we see the same circuit as before, only now we have a signal voltage being applied. You will notice that as the signal voltage rises in a positive direction, the emitter will be made less negative with respect to the base.

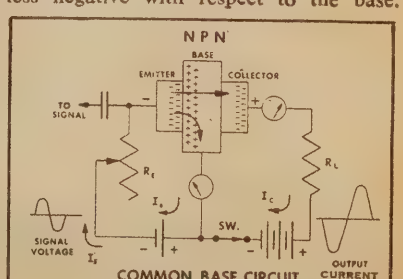



***Fig. 24. This is similar to fig. 23 but with a signal applied. The output is an amplified copy of the signal.***

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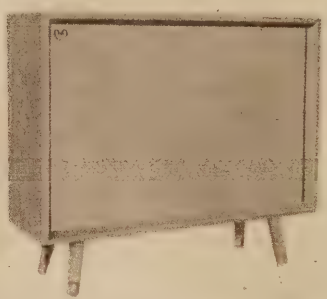

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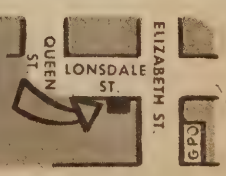


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This will result in a reduction of the forward bias of the emitter base circuit and therefore a reduction in current flow through the emitter.

Since the emitter current is reduced, the collector current will likewise be reduced at the same proportion.

As the signal voltage starts increasing in a negative direction, the emitter will now become more negative with respect to the base resulting in increased forward bias in the emitter base circuit and increased current flow activity in the emitter. This will result in a corresponding increase in collector current.

We now have reproduced the signal being applied to the emitter base circuit in the collector circuit; however, it has been greatly amplified due to the fact that the current flowing in the collector circuit is through a higher impedance network.

This can be seen by the relative size of the signal voltage present across the load resistor RL as compared to the size of the signal voltage curve in the input circuit.

We have discussed the operation of the NPN type transistor. It is also possible to reverse the sequence of the germanium pellets giving us a NPN type transister.

In Figure 25, we can see a common base type circuit, similar to the one we just discussed in which the NPN transistor has been replaced with a PNP transistor.

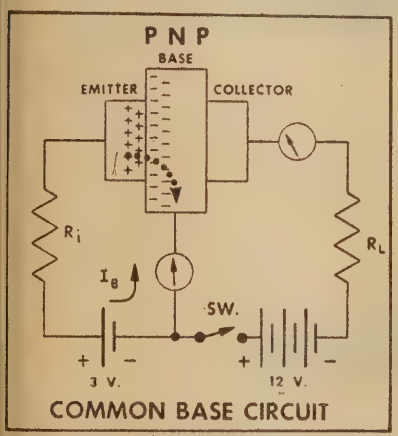


*Fig. 25. The common base circuit using a PNP type transistor in place of the previous NPN types.*

Notice that the switch in the collector circuit is shown in the open position, and the battery in the base emitter circuit is connected so that the positive electrode is to the emitter and the negative electrode to the base. This is just the opposite of what we had with the NPN transistor; however, this connection also will give us forward bias.

The application of the positive voltage to the P-type emitter will repel the positive holes in that element toward the emitter base junction. The negative voltage being applied to the N-type base will repel the electrons in that element toward the base emitter junction.

The holes in the emitter will move at high velocity and puncture the junction, thereby allowing an electron to enter the emitter from the base.

The movement of these holes through the base emitter junction will constitute our base current IB. This current will occur under static conditions and will constitute our forward bias current.

When the collector circuit switch is closed, Figure 26A, we again see that collector current results since the holes passing through the base emitter junction will enter the strong negative field set up by the reverse bias connection on the collector base circuit.

Therefore, ninety-five per cent or more of the holes leaving the emitter will pass right on through the base region and enter the collector circuit.

When a hole enters the collector circuit, an electron will enter the collector from the battery through RL to neutralise the excess hole that now exists there.

This results in electron current flow through the external circuit. Here again our collector current is slightly less than our emitter current, but the collector current will result in voltage amplification across RL, a much larger resistance.

In Figure 26B, we see that we have applied a signal through a coupling capacitor to the emitter so that the input signal is developed across R1. As the signal voltage causes the emitter to be driven more positive with respect to the base, the emitter base current will naturally increase.

This increased activity in the emitter will also result in an increased collector current, resulting in an amplified voltage being developed across the load resistance RL.

As the signal voltage swings the emitter in the negative direction, the emitter forward bias is decreased resulting in less current flow through the collector circuit and giving us an exact duplicate of the input signal across the load resistor RL, except that the voltage has been amplified.

Another circuit that will be encountered quite often will be the common emitter circuit. You will notice in Figure 27 that the base is returned to the emitter and the collector is also returned to the emitter. We have the base emitter circuit biased in the forward direction by means of a small battery with the negative electrode connected to the N-type base and the positive electrode connected to the P-type emitter.

Here, as before, the positive voltage on the emitter will repel the positive holes toward the base emitter junction through which they will pass giving us base emitter current. With the switch in the collector circuit open, we notice that we have one milliamp of base emitter current.

You can see also that the battery in the collector circuit is placed so as to inject reverse bias between the collector and base. When we close the switch, we will find the result to be rather startling.

You will notice that with the switch in the collector circuit closed (Fig. 28) our base emitter current is still one milliamp and our collector current reads twenty milliamps. Since the input is across the base emitter and the output is across the collector emitter, we see that we now have a current gain of twenty.

Let's see how this takes place. As we said before, the holes that leave the

# STATIC & DYNAMIC CONDITIONS

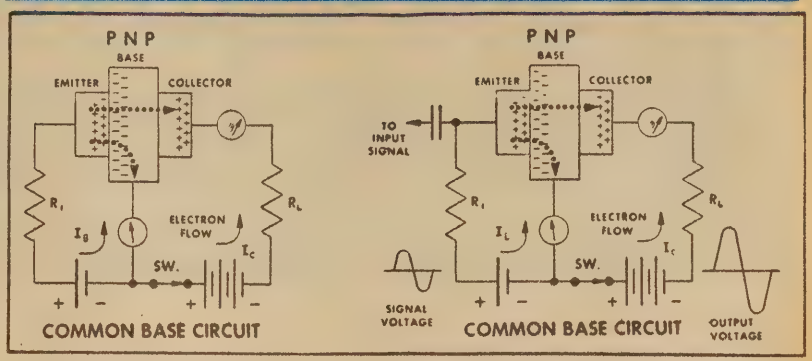


*Fig. 26A (left) shows the static conditions for the PNP common base arrangement, while 26B (right) is the same set-up with signal applied.*

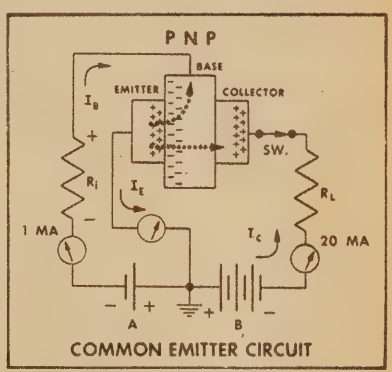


*Fig. 28. The common emitter circuit with voltage applied to the collector. Note that the collector current is many times greater than the base current.*

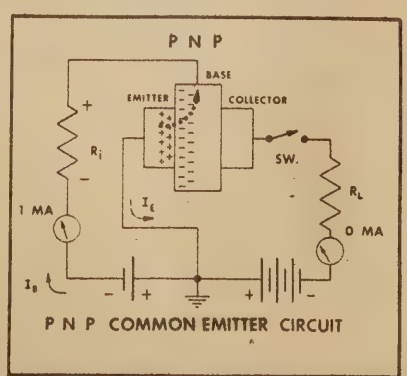


*Fig. 27. Demonstrating the principle of the common emitter circuit. As shown, there a current flow through the emitter/base junction only.*

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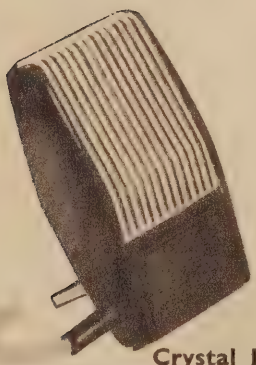

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emitter will enter into the base region, but due to their high velocity, and due to the strong negative field put out by the collector, will pass right on through the base material and enter the collector.

Only five per cent or less of those carriers leaving the emitter will enter the base and return to the emitter through that circuit. The other ninety-five per cent or more, will enter the collector and constitute collector current. Now we can see that under static conditons, we do have base emitter current and we also have collector current, even though the collector is biased in the reverse direction.

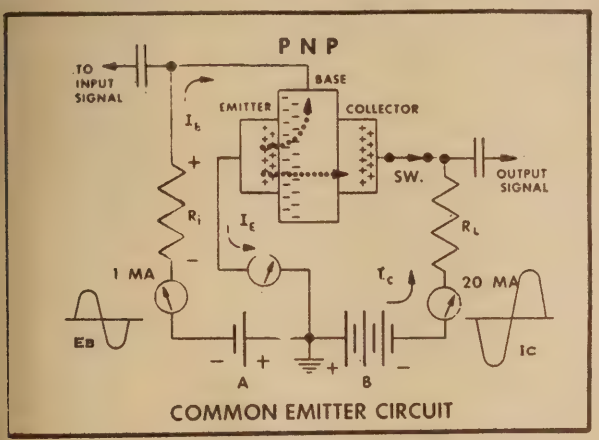



*Fig. 29. Similar to fig. 28, but with signal currents flowing in the emitter/base circuit. An amplified signal appears in the collector circuit.*

As Figure 29 shows, we have injected a signal into this common emitter circuit. You can see that the signal is injected between the base and emitter, which is a low impedance, low current circuit. The output is taken from the collector, which is a high impedance, high current circuit.

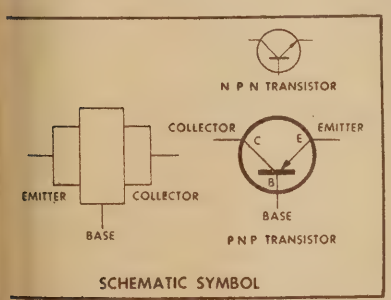



*Fig. 30. The conventional symbols for the NPN and PNP transistors. Direction of arrow signifies which is which.*

As the input signal causes the base to swing positive with respect to the emitter, it decreases the forward bias of the base emitter circuit, thereby causing a decrease in the collector current.

During the negative half cycle of the input signal, the base is driven more negative with respect to the emitter, increasing the forward bias and allowing more current carriers to be released from the emitter, which will result in an increased collector current.

You can readily see that this type of circuit would be an excellent voltage amplifier as well as a good current and power amplifier. Current gains of very high values are possible with this type of circuit.

For instance, if ninety-six per cent of all the current carriers leaving the emitter went on through to the collector and only four per cent combined with electrons in the base region, our current gain would be twenty-four.

If the percentage of current carriers reaching the collector was ninety-eight per cent and only two per cent combined with electrons in the base material, our current gain would be forty-nine. The common emitter type circuit will probably be the most frequently used type of configuration in transistor circuitry.

Up until now, we have indicated the transistor by means of blocks for each of the three elements. The most common type of symbol that you will encounter in circuit diagrams on transistorised radios is shown by means of Figure 30. The emitter element is always indicated by the line with the arrow on it.

If the arrow is pointing in towards the base, this signifies an NPN type transistor. If the arrow points away from the base, this signifies an NPN transistor. The base is readily recognisable because it will always be shown as terminated by a straight line. The collector is the remaining line which does not have an arrow on it.

## EXAMPLE

To show the use of these symbols, Figure 31, you will notice we are using a NPN type transistor (the emitter arrow is pointing in towards the base). Again we have forward bias applied to the base emitter circuit by means of the small battery which causes a small amount of static base emitter current.

The collector circuit is biased in reverse since the negative electrode of the larger battery is connected to the positive or P-type collector. Here again, the signal being applied to the circuit is varying a small base emitter current and thereby varying the larger collector current. The current carriers leave the emitter, enter the base region, and at least ninety-five per cent of them enter into the collector.

Although we have until now always provided bias by means of two batteries, in Figure 32 we can bias a transistor circuit by means of a single battery and a voltage divider network. Notice that we accomplished a reverse bias on the collector by means of the negative terminal of the battery being connected to that collector.

From the positive terminal of the battery to ground we find a two resistor series network.

With this arrangement there will always be some current flow through the two resistors and the voltage developed across the Resistor R2 due to this current will be the bias voltage for the emitter base circuit.

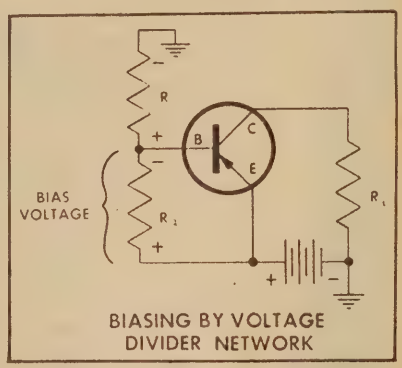



*Fig. 32. A more practical circuit for providing forward bias for the emitter/base junction, using only one battery.*

Since the voltage developed across this resistor will be negative on the base side and positive on the emitter side, this voltage will bias the base emitter circut in the forward direction.

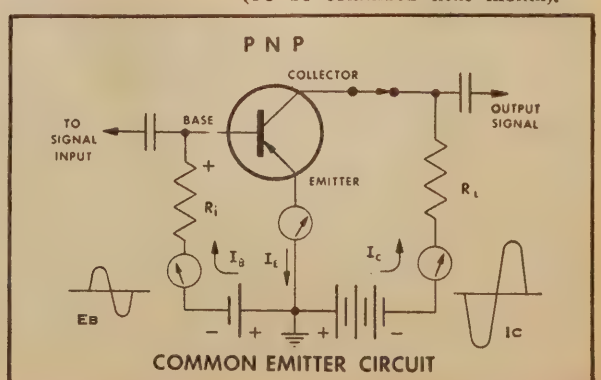
Some circuits using transistors will also use the self-bias method which is a very common system used with valves.

To prevent moisture from entering, most transistors are hermetically sealed. In addition, power transistors are operated at higher current levels which causes heat to be generated.

This heat must be distributed into a chassis or special heat sink, or the transistor will be damaged. For this reason, power transistors are bolted down firmly to a surface designed to dissipate the heat.

**(To be continued next month).**

*Fig. 31. Similar to fig. 29, but using the conventional symbol for the transistor.*



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# THE NEW RF TRANSPORTA 7

(Continued from Page 53)

peak is reached. This adjustment is quite sharp and should be carried out carefully. Failure will not only prejudice the sensitivity of the set, but also the selectivity ahead of the mixer and, with it, the ability to reject those signals which can cause "birdies."

Two rubber grommets may be used to hold the aerial coil in position on the rod although it is simpler to fasten it in position with a strip of adhesive tape.

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Tuning again to a station at the high end of the band, the RF and aerial trimmer capacitors should now be peaked for maximum signal. It is wise to go over the alignment a second time to minimise any interaction between the tuned circuits. All the trimmers should be sealed with a spot of wax or varnish.

The IF transformers may now be peaked for maximum response. Tune a weak but steady signal and commencing with the second IF transformer adjust the cores in turn for maximum signal. Note that the second IF has only one adjustable core but that the first IF has two. Repeat the IF alignment to ensure the optimum setting of all three cores. Should experiments with the size of the neutralising capacitor be attempted, each adjustment will necessitate the re-peaking of the IF transformers for maximum output.

If a signal generator and output meter are available, alignment of the IF's should be carried out first. The signal generator should be connected across the RF section of the tuning gang and the output meter across the output transformer primary. Make sure that any external connections made to the set do not provide a DC path as bias conditions may be upset with consequent damage to the transistors. A small blocking capacitor in series with the generator lead is all that is required.

## IF ADJUSTMENT

Set the generator to 455 Kc and proceed to peak each IF transformer, beginning with the second stage. For the front-end alignment, the generator should be set to 600 Kc at the bottom end of the band and 1400 Kc at the top end. The output of the generator should be fed into the aerial lead on the aerial coil for the initial front-end tune up but for final peaking it is better to feed it into a loop of wire loosely coupled to one end of the ferrite rod.

This covers all the necessary construction and alignment details and the reader should have no difficulty in completing for himself this first class little set which will give an excellent account of itself even under difficult conditions.


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# Let's Buy An Argument

**It's a rather disturbing experience for any technical writer to receive a letter beginning "I thought I understood such-and-such a subject until I read your explanation." Well, just such a letter appears on the opposite page, addressed to Yours Truly. I suggest you read it.**

by Neville Williams

MY first reaction, on receiving the letter was to hasten to an apology. After all, it's a serious thing to confuse a man whose thoughts, previously, were so lucid.

But then I paused. Perhaps it isn't such a serious thing to unsettle assumptions which are based, in whole or in part, on dubious grounds. One might even be doing a service to the person concerned.

We shall see.

## MILLER UNDER FIRE

Our correspondent's first step is to question the whole basis of Miller Effect calculations by suggesting, apparently, that if such capacitance does in fact exist, it is in series with the parallel resultant of the plate load and the following grid resistor.

These would greatly reduce its effect in terms of current flow across the capacitive path to the valve's own grid. Therefore (we presume) Miller Effect is not nearly as serious in practice as it is commonly made out to be.

I am very much afraid that, in saying or inferring this, J.R. could be accused of taking two bites at one and the same cherry.

The source of feedback to the grid is the instantaneous signal voltage actually developed at the plate of the valve. The relationship of this voltage to the grid voltage could be expressed, easily enough, in terms of transconductance, plate load, following grid resistor and internal plate resistance— a quantity which our correspondent surprisingly fails to mention.

**In fact, the Miller Effect formula uses "M," representing effective stage gain. All the quantities in question are implicit in "M" because they must be used in its calculation.**

What is more, the figure so obtained is regarded as sufficiently accurate for normal Miller Effect calculations, because the load and therefore the basic stage gain is not likely to be affected much by the simple impedance of the feedback path.

For all practical purposes it is normal to consider "M" as the nominal middle frequency gain and to apply the formula in its naked simplicity.

It should be unnecessary to point out that I didn't invent the original formula. It is well known and widely accepted. All I did was to re-state it and attempt to explain the effect in words.

## WORTHY OPPONENTS

If J.R. wishes to question the basic formula, he can choose his opponents from rather distinguished company.

For example, in the Radiotron Designer's Handbook (3rd edition, page 46) Mr F. Langford-Smith, B.Sc., B.E., describes the evolution of the classic formula, then proceeds to calculate the apparent input capacitance to a 6B6-G high-mu triode.

It comes out at an impressive 105uuF. with no mention of any factors which might offset it.

And having observed the Miller Effec losses with such high-mu valves in prac tical amplifiers, I have no persona doubts that they are very real.

My further suggestion that Mille Effect losses involve the TOTAL capac tance between grid and plate is nothin more, to my mind, than a statement o the obvious.

## IT'S STILL CAPACITANCE

If capacitive feedback produces ce tain effects, as per the formula, then surely cannot matter whether the capac tance occurs inside or outside the gla envelope; whether it is incidental, acc dental or deliberate.

I'm afraid I can't yield on this one.

If evidence is required in support this, see a reference on page 48 of t text already quoted. Herein is discusse an automatic tone control system which natural Miller Effect is augmente by the addition of a small extern capacitor between the grid and plate an AVC-controlled audio amplifier.

Again, I seem to be in fairly good company.

J.R.'s second line of approach, involving the negative feedback concept, boils down to this:

(1) With input capacitance due to Miller effect, the gain reduction curve with increasing frequency is asyntotic to a figure of something less than unity.

(2) With an actual physical input capacitance, the gain reduction curve with increasing frequency is asyntotic to zero gain.

Therefore the two are not the same and the whole Miller Effect concept presumably collapses.

Frankly, I have not seen this argument advanced before, though I am still sufficiently immobilised by a recent accident to prevent me from making a search through other textbooks. But, in any case, the effect would be very much of a second order, when considered from the original viewpoint—that of undesirable treble attenuation.

## EXAMPLE

Consider, for example, the case of a 6B6-G, as already mentioned. With a gain of 60 times at low and middle frequencies, input capacitance will cause a roll-off above a particular region, reaching a rate of 6db per octave.

It would be of little practical consequence whether the said curve was asyntotic at its lower extreme to unity or to zero. Long before reaching this extreme, the curve would already have spelled out a quite inadmissible decibel loss in the treble region.

But, once again, if our correspondent wants to question the order of the effective capacitance or the loss which it can bring about, he had best tackle the engineers who evolved the formula in the first place.

I'm afraid that J.R.'s final reference to a practical frequency compensating stage does as much to destroy as to bolster his argument.

First and foremost it can be misleading to regard this as a bass-boost circuit even though it ostensibly has this effect on the overall frequency curve.

It is really a treble loss circuit.

Neglecting, for a moment, the 1-meg. resistor, the valve would give substantially NORMAL GAIN at very low frequencies, where the reactance of the .005 feedback capacitor is very high.

At somewhat higher frequencies, where the reactance of the capacitor starts to become significantly smaller, there would be a progressive reduction in gain, so that low frequencies would receive greater amplification than those higher in the register.

## BASS BOOST?

So, a bass-boost effect is achieved by virtue of treble attenuation.

J.R. says that there is a very large amount of boost—so much that he had to take steps to limit it.

What he really should say is that there is a very large amount of treble cut and this is exactly what one would expect of such an arrangement.

It is eloquent testimony of what a capacitive feedback path can accomplish with a high-mu triode. It supports, not destroys the (M plus 1) effect.

He objects further that, if the Miller effect formula applied, the roll-off would commence above 30cps. Presumably, this would be preposterous.

On the contrary, it is exactly what one would expect, and exactly what should happen.

J.R. says that it is a very good bass-boost circuit and a bass-boost circuit wouldn't be very good unless it did give maximum gain in the 30-cycle region and commence to roll off thereafter.

Having looked at many such curves over the past 20 years, it is entirely consistent for it to "bottom" or flatten out again in the 500-1,000 cycle region.

In other words the evidence brought forward to confound "Miller Effect" and its relationship to an external capacitor, succeeds admirably in supporting it.

The one point that J.R. seems to have made successfully is that the curve, in the region of maximum attenuation, is asyntotic to a very low value — not to zero. For a compensating stage this is important; in terms of unwanted treble loss, it would be so many db down as to be of minor interest, as already mentioned.

Out of all this we can draw a curve of the likely response pattern of our correspondent's compensating circuit.

Without the 1-meg. resistor, the stage would give near to full gain in the very low frequency region. Commencing at about 30 cps, on J.R.'s own calculation, a downward roll would be evident over several octaves, till flattening again somewhere below 1,000 cps.

## LIMITING RESISTOR

The effect of the 1-meg. resistor would be to impose a certain minimum order of feedback so that the gain would not rise to maximum below 30 cps, but rather follow the curve as dotted.

Which leads us to the further observation that the resistor is not necessarily in the best position:

# "I UNDERSTOOD MILLER EFFECT"

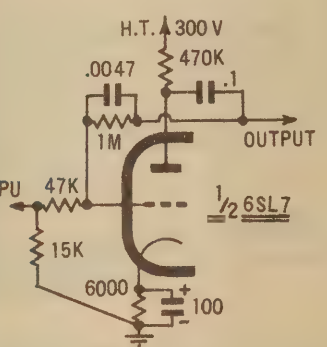
*Dear Mr Williams,*

*LET'S BUY AN ARGUMENT. Until I read your exposition in the August issue I thought I understood Miller Effect. Now I wonder.*

*You have categorically stated, in effect, that any capacitance between plate and grid of a tube, whether inside or outside the tube, takes part in producing the Miller Effect.*

*Now my first criticism of your explanation is that, except in your first example, where plate load is zero ohms, any such capacitance is not directly between grid and earth but is in series with (a) the plate feed resistor and (b) the following tube's grid resistor, these being effectively in parallel. Such resistance can be as high as 200,000 ohms.*

*My second criticism involves approaching the problem from another viewpoint. A capacitance between plate and grid amounts to a feedback path in series with the*




*grid leak and forming a voltage divider whose upper leg varies with frequency.*

*At low frequencies the grid leak would be a small fraction of the total impedance between plate and earth via grid and the amount of feedback small.*

*At very high frequencies the grid leak would become the greater part of the total impedance, the amount of feedback would approach 100 per cent and the gain of the stage reduce from M to M/(M + 1).*

*Notice, however, that it could never reduce to any lower figure, BUT if the capacitance between plate and grid were really equivalent to a capacitance from grid to earth, whether multiplied by (M + 1) or not, it would inevitably tend to reduce the output signal* **indefinitely** *as the frequency rose.*

*As a matter of fact, I am using a capacitance feedback circuit for bass boost, based on the considerations I have outlined.*

*Bass boost starts to be appreciable at 500 C/S; above 1KC it appears to be pretty well flat. Actually at very low frequencies there would be too much boost, hence the 1 meg. resistor in parallel with the .005 condenser.*

*The pickup is a comparatively low impedance magnetic, consequently the total impedance from grid to earth via the isolating resistor would be something between 47,000 and 62,000 ohms, say 55,000.*

*Now, if the .005 condenser were effectively between grid and earth it would operate as a bypass with a time constant of .000275, involving 6 db per octave attenuation above approximately 2,000 cycles.*

*Moreover, if it were effectively multiplied by about 50, due to Miller Effect, the time constant would be about .0138 and the 6 db per octave attenuation would commence somewhere below 30 cycles.*

*Over to you.*

*Yours faithfully, J.R.*

*P.S.: Have been an avid reader of your journal right from its first issue and prior to that, of the old Wireless Weekly. I always turn first to L.B.A.A. when I open a new issue. Best wishes for continued success of your excellent magazine.*

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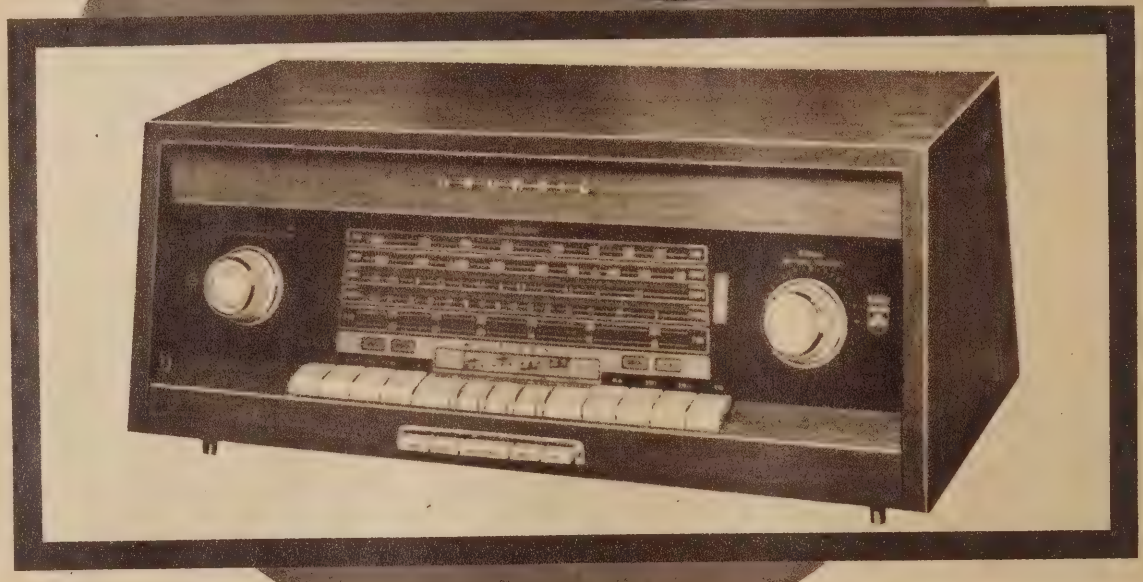

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(1) It prevents the bass boost from full development in the very low frequency region and,

(2) It never allows the stage to develop the full gain of which it is capable.

By placing a resistor in series with the capacitor:

(1) The bass boosting effect is able to continue more readily into the lower frequency regions and

(2) a limit is set on the maximum feedback and therefore the loss in the middle and upper register.

By carefully selecting the components, the curve can be made to flatten below the 30-cycle region, roll by the requisite number of db towards 500-1,000 cps. and flatten again, without sacrificing more gain than is strictly necessary.

Figure 1b shows what I mean.

So much for Miller Effect.

## NOT SATISFIED

In the September issue, I answered a question relative to the ARTS and P. label affixed to radio and television receivers.

As you can see from the letter in the above panel, one reader is not satisfied with what I had to say. He would like to have seen something more "official" and would possibly have welcomed, most of all, something to indicate that labels and patent responsibilities could be forgotten once and for all.

By way of elaboration, let me remind our correspondent that matters to do with patents are notable for their complexity and hotly contested matters can drag on for months, even years. In that period, legal fees accumulate in a most alarming fashion.

Any serious move to upset the present patent system would certainly be "a hotly contested matter," with legal fees to match.

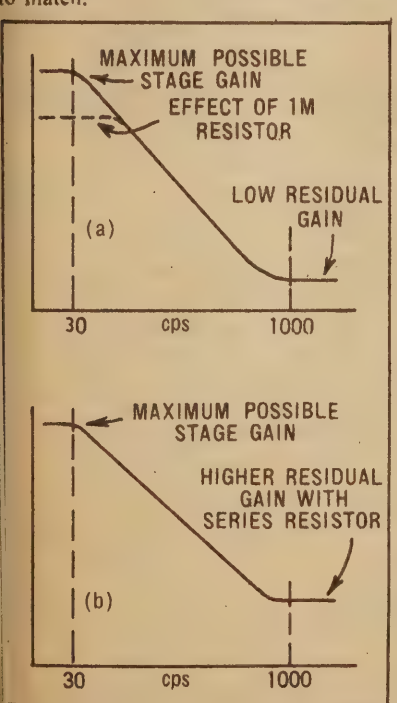


***Figure 1a indicates the likely response curve of the compensating stage mentioned by J.R. Curve (b) suggests the possibly higher middle frequency gain which would be obtained with a shunt rather than a series resistor.***

## THAT ARTS & P LABEL

*Dear Mr Williams,*

*Thank you for answering the legal case FOR the ARTS and P label on a radio.*

*It is a pity that R., TV and H. couldn't afford £3/3/ to get about twenty lines on the case AGAINST.*

*You say "some are vital patents and some may have lapsed."*

*It stands to reason all vital patents have lapsed, due to the passage of time.*

*This would probably be less so on television parts and circuits but, in terms of radio, it seems that setmakers may find it worthwhile to re-examine their legal position.*

*Yours sincerely, M.G.*

What use would be served by three guineas, I leave you to imagine.

That is why I opened my earlier remarks with the paragraph, which could stand to be repeated, as follows:

"If one wanted to examine in any detail the legality of the label in question, it would have to be done on a legal plane—not via a question to a technical magazine. And considering the time and money which could be involved, one would not institute such an inquiry without having a definite objective in view."

As far as I am concerned, that paragraph still stands.

M.G. goes on to make a statement which could well become a classic in some circles. Like "Doctor Livingstone, I presume."

He says: "It stands to reason all vital patents have lapsed, due to the passage of time."

If so, then a lot of people must currently be "earning" a living by false pretences.

## POSITION AS STATED

It is perfectly true, as I stated in the September issue, that many patents have lapsed, that many are of no great value, that many are open to challenge and so on. It is probably true that television, being the later and more complex art, is subject to more extensive patent coverage than radio.

But the pool of patents is continually being added to and I am assured that there are many thousands of patents still active. Nor is there any immediate sign of the stream drying up.

Among these many thousands are plenty of "key" patents.

One patents officer—not an ARTS and P. spokesman—put it to me this way:

Imagine yourself trying to operate as a radio and television manufacturer but limited, by your no-royalties policy, to techniques which were current 20 years ago.

Your television sets would be obsolete before they were ever made.

You would have no transistor portables.

You would have no transistorised or transistor-powered car radios.

You might be able to make broadcast receivers, which are in low demand anyway, but not without a very careful preliminary search. Otherwise, you might get trapped on such things as core materials in the coils and IF transformers.

The same officer assured me that there was no secret about the relevant patents. Anyone who had the inclination to do so could go through them, though it would probably take weeks or months even to read through the words. To examine them critically would take much longer.

Nevertheless, the job had been done, he said. More than once the position had been examined, on an industry basis, to see whether continuation of the scheme was warranted.

The system and the ARTS and P. organisation still exists, with no further challenge pending that I know of.

What is more, similar systems are currently operating in other countries and for the same reasons.

Personally, I expect to see the ARTS and P. label around for quite a while yet.

I'd rather spend the three guineas some other way!


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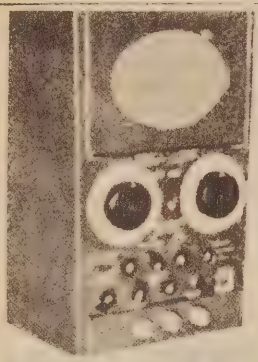

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## TELEPHONES

TYPE F MAGNETO Table Model. Long Range — Tested. Perfect Order.

**£3/19/6**

Cable to suit, new, 1-mile. drums, £1/7/6

## V.H.F. TRANSMITTING VALVES

New. Current. Not war-time manufacture.

832A-QQ/04/15

**19/6**

4/125A—4D21—QY3/125

**£4/15/- EA.**

## GENEMOTOR SPECIAL

28-32v. 300v. 250mA. Will operate TV sets.

**£1-7-6**

## New Coils and Intermediates

Standard or miniature to suit all valves

| | |
|---|---|
| Coils B/C, 455 KC | 9/6 |
| Coils S/W, 455 KC | 9/6 |
| Inters | 11/6 |
| Loop aerial coils | 9/6 |
| Slug tuned H.F. coils to suit 44 mcs. | 4/6 |

## 28-32V VIBRATOR POWER SUPPLIES

Regulated 150v. output.

**£1-17-6**

## NEW TRANSMITTER POWER SUPPLIES

240v., 50 cycle. 1200v., 500mA; 275v. 200mA. 6.3v. 12 amp. DC. Fully filtered.

**£19-17-6**

## WANTED

Communications Receivers. Test equipment, P.A. Gear. Large or Small surplus stock. Best prices. Call, write or phone any time.

## DYNAMIC HEADPHONES

Low impedance 17/6

Postage 2/6.

Dynamic microphones, type 7, 12/6 Postage 2/.

## No. 19 TRANSCEIVERS

Complete with 15 valves and power supply.

**£12/17/6**

## P.A. SPEAKER UNITS

P.A.7. New condition

**£7/10/- EA.**

With short aluminium Horn and Line Transformer.

**£8/10/-**

## ARR2 RECEIVERS

12v Operation. 11 Valves. 3-6AKS 7-9001 12-A6 V.H.F 234-259 Mcs. Plus 6 Channels. Broadcast and double conversion. New condition. Including Valves and Circuit.

**£7/17/6**

## NEW ROTARY CONVERTERS

160 watt. 50 Cycle. 24v to 32v input. Output can be supplied for 50-110 or 240v as required. Suit radiograms, TV, tape recorders, fluorescent lights.

**£19/17/6**

240V A.C.

## TYPE S POWER SUPPLIES

As used for AR8-AT5 Stations 575V 350mA plus 250V, 100mA Plus 12V DC 10amp. Tested New Condition

**£18/17/6**

## MINE DETECTORS

Ideal for tracing water pipes, locating metals, etc.

**£5-17-6**

## 522 TRANSCEIVERS

Complete with Valves. Excellent Condition.

**£12/10/-**

522 Receivers. Complete with Valves **£5/17/6**

522 Transmitters. Complete with Valves **£7/15/-**

## LIGHTING PLANTS

12v. 300 watt. Direct coupled to 1 h.p. petrol engine. Tested. Perfect order.

**£36/10/-**

115v D.C. 2½ amp. As above. New. £29/10/.

## AIRCRAFT GENERATORS

28V. 100AMP. £12/17/6. 28V. 60AMP. £10/10/-.

## 1154 TRANSMITTERS

100 watt output. Complete with Valves and meters, £4/17/6.

## AT5 TRANSMITTERS

Complete with Valves. £5/17/6.

## NEW POTENTIOMETERS

2 meg. 1 meg. ¼ meg. Linear, Tub., Pots.

**2/- ea. 21/- doz.**

## DUAL CONCENTRIC

1 meg plus 200K plus DPST switch. 1 meg plus 2K standard spindles.

**7/6 ea. £4/-/- doz.**

# A.E. RADIO

PHONE LA 3845

136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N·S·W

## 636 KING STREET NEWTOWN–LA7008

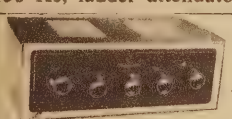
# 5" OSCILLOSCOPE

Vert. response: 1.5 meg.
Sensitivity: 120 m.m. per volt.
Hard time base: 20 to 150 Kc.
Push-pull deflection.
Ladder attenuator.
Calibrated: P. to P. volts.
Cathode follower input.
Probe receptacle.
Frequency compensated input.
Input to deflection plates.

**£42/10/-**

### 3-inch WIDE BAND C.R.O.

Band width: 3.5 megs, plus or minus 3 db.
Sensitivity: 60mm per v. calibrated.
7 miniature valves, P.P. deflection, hard T.B., 20 cycle to 150 Kc, ladder attenuator, cathode follower input **£47/10/-**



### PLAYMASTER STEREO UNIT NO. 2

7 watts per channel.
R., TV and H., Sept., '60.
Complete kitset including cabinet and Ferguson high-quality U.L. tapped O.P. transformers.

KITSET, **£37/10/0**
WIRED and TESTED, **£42/-/-**
Cabinet, Chassis, Front Panel and Plate, £4/10/.

### TV KITSET

23-inch, 110 degree. Latest. Flat, square front.

**VISTAVISION**

Fringe area tuner. Side tuning. **£110** Latest framegrid valves.
Wired and Tested, £12 extra.

### STEREOGRAM CHASSIS

Dual Wave with RF Stage.
8 VALVE, 6BA6, 6AN7, 6N8, EM80, 12AT7, 6BM8, 6BM8 5Y3.
2 Rola 8MX Speakers.
**£38/15/-**

10 VALVE, 6BA6, 6AN7, 6N8, 12AT7, EM80, 2 x EF86, 2 x EL84, 5V4.
2 Rola 8MX Speakers.
**£49/15/-**

Send for full details on Radiogram Chassis, TV and Amplifiers.

15 VALVE, 2 x 6BA6, 6AN7, 6AV6, 6BR5, 2 x EF86, 12AT7, 2 x 12AX7, 4 x EL84, 5AS4.
4 Jensen Speakers.
**£66/15/-**

### PRODIS Sweep Generator UNITS

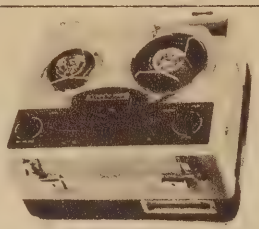
VU., TV, IF, Band,
**£7 Net.**
VSUI, IF and SOUND,
**£14/-/-**

### PORTABLE STEREOGRAM

2 toned. Plastic covered Cabinet.
4 speed Stereo player.
2 Speakers. 6 watt output.
**£32/17/6**
With built-in tuner. £7 extra.

### Battery Chargers

To charge 6 and 12-volt, 3 amp. **£5/15/-**
6 and 12v, 4 amp.
**£6/15/-**
Other Ratings To Order.



### PORTOTAPE TR 101

2 Speed, 2 Track.
3¾ and 7½"/sec.
Frequency response 60 to 8500 cps.
2 hours play on L.P. tape.
Complete with mike, tape, spools, etc.
240v. AC operation.
Weight 16½lb.
**£51/15/0**

### RADIO CORDER

Built-in tuner. 2 track. 3¾"/sec. 60 to 10,000 c.p.s. Input for mike, P.U., etc. Output for ext. speaker. Also to HI impedance.
Complete with crystal microphone, Tape, Spools.
Weight 25lb.
**£65/0/0**

### AMPLIFIERS

Public Address Range
240v-AC

6 Valve, 10 watt, **£14/17/6**
6 Valve, 25 watt, **£25/17/6**
6 Valve, 40 watt, **£32/7/6**
7 Valve, 20 watt, **£22/17/6**
100-watt . . . . . **£63**

### Battery Operation

6 valve 6v, 10 w **£18/15/**
7 valve, 12v. 12 watt, **£19/15/**
7 valve, 12v. 25 watt, **£24/17/6**

### BATTERY-AC OPERATION

6 valve 6 x 240 10 watt, **£20/15/**
7 valve 12 x 240 12 watt, **£21/15/**
7 valve 12 x 240 25 watt, **£29/7/6**

### TRANSPORTER 7

With RF stage.
Using drift type transistors.
Improved range and performance.
**KITSET . . . . . £25/17/6**
**Wired and tested . . £29/7/6**

### LEADER Signal Generator

240v. AC power.
6 band. Accuracy 1 p.c.
120 Kc to 270 megs.
**£15/15/0**
Post, N.S.W., 7/6; Int., 10/.

### MULTIMETER

20,000 O.P.V. sensitivity.
Ranges:
DC volts, 0, 10, 50, 250, 500, 1000.
AC volts, 0, 10, 50, 250, 500, 1000.
DC current 0.50uA, 0.25, 0.500mA.
Resistance, 0.50K, 0.05 meg, 0.5 meg.
D.B. minus 20 to plus 36.
**£6/19/6**

### MODEL K.2

2000 O.P.V. Sensitivity: Ranges as above except 50 uA.
**£4/19/6**
Post, N.S.W., 3/6; Int., 5/6.

### METERS

Flush mounting.
2¾" moving coil. .1mA.
**£1/19/6**
0 to 50uA.
**£3/17/6**

### STEREO PLAYER

4-speed.
**£10/17/6**
Stereo Changers, 4-speed,
**£14/17/6**

### RECORDING TAPE

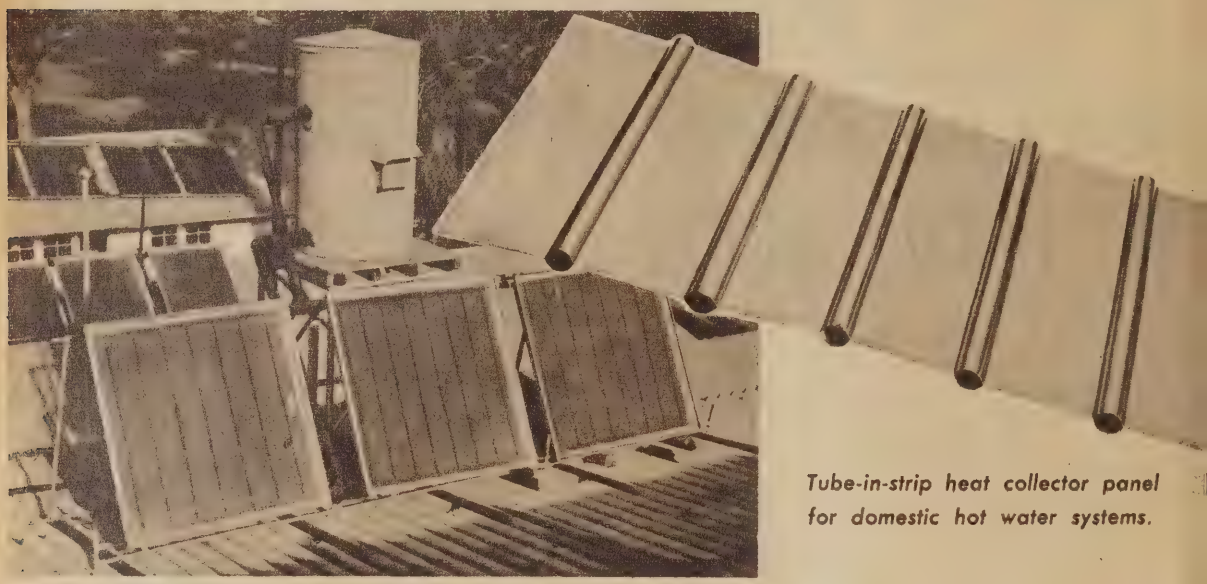
Hi-coercivity tape, ex A.B.C. Stations.
1,200 spools . . . . . £1/7/6
600ft spools . . . . . 19/6

### TV ANTENNAE

A Complete Range from
**£4/15/-**

# A NEW APPROACH TO HEAT EXCHANGE!

## COPPER TUBE-IN-STRIP ✳



*Tube-in-strip heat collector panel for domestic hot water systems.*

✳ Austral Bronze Company manufactures Tube-in-strip under exclusive licence granted by Revere Copper and Brass Incorporated, U.S.A.

Tube-in-strip is a sheet, or continuous coil of copper, having a number of parallel tubes integral with the sheet. It is completely homogeneous without welds, brazing or other bonding.

Because of its incomparable ability as a heat transfer agent, its ability to resist corrosion and economy of installation, Austral Alloy 102 Copper Tube-in-strip is used as the absorber panel in solar heat applications. These same characteristics make it ideal for:

**REFRIGERATION**
**AIR CONDITIONING**
**HEAT EXCHANGERS**
**INSTRUMENT LINES**
**WATER HEATERS AND COOLERS**

**RADIANT PANEL HEATING**
**BASEBOARD RADIATORS**
**AUTOMOTIVE**
**AIRCRAFT**
**SOLAR HEATING**

**ELECTRICAL INDUSTRY**
**AUTOMATION**
**FOOD PROCESSING**
**BEVERAGE INDUSTRIES**
**ARCHITECTURE AND BUILDING**

**AUSTRAL BRONZE COMPANY PTY. LTD.**

*Enquire from your nearest Austral Bronze sales office*

128-130 Rothschild Avenue
Rosebery, MU 4443

463 Torrens Road
Woodville. JL 5366

473-479 Swan Street
Burnley. JB 4323

101 St. George's Terrace
Perth. BA 7072

224 Montague Road
West End. J 6562

Box 42, P.O., Glenorchy
Hobart. 7 6887 Hobart

AB142/1C

# TRADE REVIEWS AND RELEASES

## NEW 'PRECISION' GENERATOR COVERS WIDE RANGE

**An interesting item in the "Precision" range of test equipment is the Model F-200C "signal-Marking" Generator. As the name implies, it is suitable for use as a signal generator in laboratory or service workshop, but it is designed also as a companion marker unit to the Sweep Signal Generator, mentioned last month in these pages**

THE Model E-200C is a multi-band generator covering from 88 to 110 megacycles on fundamentals and up :o 440 megacycles on harmonics of the highest fundamental range. All fre-quencies are calibrated directly on the 10-band scale and the makers guaran-:ee a calibration accuracy of 1 per :ent.

For repeat spot-readings, use can be made of a special 0-100 scale with vernier markings on the cursor.

The instrument has no provision for metered output but dual-shielded atten-uators provide a smooth control of out-put over a wide range.

In addition to the RF signal, the 400-cycle modulating voltage is available at levels up to 75 volts.

Modulation percentage is variable and calibrated between 0 and 100 per cent.

A novel feature is the provision of an adjustable negative AGC voltage which can be looped into television receivers under test, obviating the need for sep-arate batteries.

☆

***A boldly marked vernier dial is the outstanding feature of this new generator. Its price is well with-in the range of service organisa-tions.***

☆

Internally, the instrument employs liberal shielding to minimise RF leakage, an electrostatically shielded power trans-former and a filtered power lead. Sig-nal connections are by coaxial cable.

The instrument is housed in a blue-grey, hooded steel cabinet measuring 11½ x 13 x 6 5/8th inches.

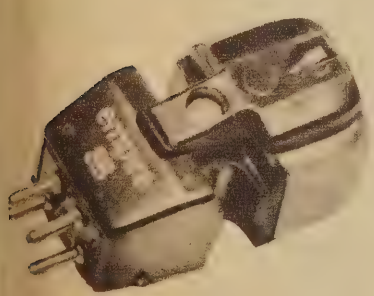
The two-colour panel is satin-brush-ed, and calibrated against laboratory crystal standards to ensurace accuracy.

The generator is supplied complete with a manual entitled "Servicing By Signal Substitution." This deals at length with the use of the instrument, as well as containing details of its in-ternal circuit.

Consumer price is quoted as £68/8/ f.o.b Melbourne. (For further informa-tion contact R. W. Steane).

## "AUDIO EMPIRE 88" P.U. CARTRIDGE

**Illustrated below is the "Audio Empire 88" magnetic stereo cartridge, currently being marketed in Australia by Pantechna Pty. Ltd. of 6A Elizabeth Street (4th Floor), Melbourne, C1.**



THE cartridge uses the moving magnet principle and has very ambitious specifications. The frequency response aimed is within plus and minus 2db from 20 to 20,000 cps, channel separa-tion better than 20db and dynamic stylus mass less than 1 milligram.

This last figure is particularly com-mendable and, along with high com-liance ensures that the stylus will track very heavily modulated grooves with low tracking weight (2 to 5 grams) and with little danger of damage to the record. At the same time, no damage is done to the mechanism of the cart-ridge if it is used as a replacement in equipment which places as much as 8 grams on the stylus point.

Of modest overall dimensions, the cart-ridge can be adapted to fit most arms and a selection of screws and bushes is sup-plied to assist the user. It can be used with mounting centres of either 7/16 or ½-inch.

Over the past few weeks, we have had the opportunity of listening at length to one of these cartridges and have been impressed by its smooth frequency response and low distortion, even on records which appeared unplayable on crystal pickups.

The one limitation of the cartridge is that it should not be used with turn-tables having the motor under the stylus arc, because of the risk of hum pickup.

The cartridge is normally fitted with a diamond stylus and delivers a nominal output of 5 millivolts into a 47K load. It combines well with the latest R., TV and H. High Gain Control Unit.

## ELECTRONIC PARTS, CHASSIS DISTRIBUTORS

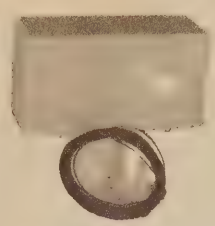
ELECTRONIC PARTS PTY. LTD. advise that they have been appoint-ed as sole Australian distributors of chassis, boxes and general metalwork produced by the well-known engineering firm of Patton Products Pty. Ltd.

Although Electronic Parts Pty. Ltd. has been active in this field, particularly with Playmaster and TV kit metalwork, their recent appointment by Patton Pro-ducts Pty. Ltd makes it possible for them to offer a complete range of chassis to suit all popular "R, TV and H" de-signs.

Stocks and all data relative to "R, TV and H" chassis will be located at the Broadway Electronics Branch, No. 206 Broadway, Sydney, which is on the First Floor of the E. S. and A. Bank Building, corner of Broadway and City Road (right opposite Grace Bros.).

# MASTER ELECTRICS PTY. LTD.

A WHOLLY OWNED SUBSIDIARY OF MOTOR SPARES LTD.

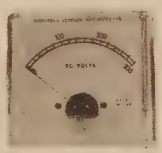


## HI-TONE TRANSISTOR MANTEL RECEIVER

Providing a good aerial and earth are used, this set will work well up to 50 miles from a broadcasting station. It uses one transistor one diode, has a 4-inch Rola Speaker and works off a 4½-volt Torch Battery. 100ft aerial wire, 2 insulators and battery are supplied. Just the thing for Christmas presents for the children. These are brand new and boxed and Australian made. Worth £7/7/-.

**Our Price £3/12/6**

M065



MR4.P.

## WIZARD METERS

**JUST LANDED, PANEL METERS**

All types, 2.5 per cent accurate. Two models available as follows:

**MO 65 Round Black Bakelite case, overall diameter 3½ inches.**

**MR4P Rectangular Plastic Case, overall size 4½ x 4½.**

**Prices are as follows:**

| Type | MR 4P | MO65 |
|---|---|---|
| 50 Micro-amp | £5 10 0 | £3 17 6 |
| 100 Micro-amp | £4 10 0 | £3 7 6 |
| 500 Micro-amp | £3 15 0 | £2 10 0 |
| 1 Milliamp | £3 10 0 | £1 15 0 |
| 5 Amps | £3 10 0 | £1 15 0 |
| 15 Amps | £3 10 0 | £1 15 0 |
| 30-0-30 Amps | £3 15 0 | £1 17 6 |
| 20 Volts DC | £3 10 0 | £1 15 0 |
| 50 Volts DC | £3 10 0 | £1 15 0 |
| 100 Volts DC | £3 10 0 | £1 15 0 |
| 300 Volts DC | £3 10 0 | £1 15 0 |
| 20 Volts AC | £3 10 0 | — |
| 50 Volts AC | £3 10 0 | — |
| 100 Volts AC | £3 10 0 | — |
| 300 Volts AC | £3 10 0 | £1 15 0 |

**Note:** All AC Voltmeters are of rectifier type. All prices plus 12½ per cent Sales Tax. Special prices for quantity on application.

## M & W TRANSISTOR TESTORS

Either N.P.N. or P.N.P. types may be tested with this efficient tester, ideal for the service shop. These are made in Germany, overall sie 5 x 2¾ x 1¾.

**Price £18/15/-**

Plus Sales Tax, 12½ per cent.

## ★ SPECIALS ★

1. **SHAVER PACKS.**—To operate 230-volt Electric Shavers from 6 or 8 volt batteries, suitable for Philishave Sunbeam and Remington, or any shaver that works off AC-DC. **A bargain at £4/10/-.**

2. **TRANSISTOR R.F.,** type P.N.P., suitable for IF and Oscillator, made in England. **Only 17/6.**

3. **VCR 138 CATHODE RAY TUBES.**—3½-inch Diameter. Filament volts 4. Filament current 1 amp, anode 2 200 volts. Grid 1=50 Volts. Anode 3=1200 Volts. Electrostatic Deflection. Colour Green. **Price, only 25/-.** Socket connections available on request.

4. **MINIATURE IF TRANSFORMERS,** 455 Kc., brand new, with retaining clip. Worth 18/6. **Our price, 7/9 ea.**

5. **STANDARD SIZE IF TRANSFORMERS,** 455 Kc. in round cans, slug tuned. **Price only 6/9 ea.**

6. **ISOCORE SPEAKER TRANSFORMERS,** 10,000 to 3 ohms. Well-known make. **Price only 6/- each.**

7. **MULTI ELECTRO CONDENSERS,** 50 mfd 200 PV, 30 mfd 200 PV, 100 mfd 25 PV. All in one can. Brand new. Worth 15/. **Our Price, 4/6 each.**

8. **MIDGET 2-GANG VERNIER DRIVE CONDENSERS.** Brand new, well-known make, capacity 10-415 PF. Worth 36/-. **Our Price, 18/6 each.**

9. **DRY METAL RECTIFIERS, Ideal for AC-Battery Portables.**—Contact cooled-type 18 RA 1181 60 ma half wave. **Only 8/6 each. Type 16K 4, Only 5/- each.**

10. **7-PIN MINIATURE SOCKETS, 6d each.**

11. **GERMANIUM DIODES,** English make, brand new and perfect. Ideal for use in crystal sets and for detectors, rectifiers, etc. **Price only 3/6 each.**

12. **SINGLE GANG CONDENSERS,** midget type, approx. .0004 mfd capacity. Ideal for any broadcast receiver. Brand new, English make. **13/9 each.**

## SPECIAL NOTICE

**All parcels sent registered Post unless otherwise stated. Postage or Freight must be included with order.**

13. **REDUCED PRICES ON TRANSISTORS.**

| | | £ | s. | d. |
|---|---|---|---|---|
| S.T.C. | TS1 | | 10 | 10 |
| | TS2 | | 12 | 11 |
| | TS3 | | 13 | 10 |
| | TS3Z | | 14 | 7 |
| | 2N185 | 1 | 3 | 4 |
| | 2N250 | 2 | 10 | 9 |
| | 2N252 | 1 | 2 | 3 |
| | 2N308 | 1 | 2 | 0 |
| | 2N309 | 1 | 3 | 3 |
| | 2N291 | 1 | 17 | 0 |
| Philips | OC16 | 4 | 1 | 0 |
| | OC16G | 2 | 10 | 8 |
| | OC44 | 1 | 8 | 7 |
| | OC45 | 1 | 8 | 4 |
| | OC65 | 1 | 10 | 8 |
| | OC66 | 1 | 10 | 8 |
| | OC70 | 1 | 2 | 2 |
| | OC71 | 1 | 0 | 2 |
| | OC72 | 1 | 0 | 10 |

14. **COIL WINDING WIRES,** available in ¼lb spools as follows. All wires enamelled.

| B and S. | SWG | Price |
|---|---|---|
| 18 | 19 | 6/11 |
| 20 | 21 | 7/- |
| 21 | 22 | 7/- |
| 22 | 23 | 7/1 |
| 24 | 25 | 7/10 |
| 26 | 27 | 8/7 |
| 28 | 30 | 9/11 |
| 29 | 31 | 9/4 |
| 30 | 33 | 10/7 |
| 31 | 34 | 11/11 |
| 32 | 35 | 13/4 |
| 33 | 36 | 13/5 |
| 36 | 40 | 19/7 |
| 37 | 41 | 21/1 |
| 38 | 42 | 27/4 |

15. **COIL FORMER.** Bakelite coil former, can be cut to any desired length to suit your requirements.

| Diameter of Former | Price per inch. |
|---|---|
| ¾-inch | 5d. |
| 1-inch | 5d. |
| 1¼-inch | 6d. |
| 1½-inch | 6d. |
| 2-inch | 8d. |
| 2½-inch | 9d. |
| 3-inch | 10d. |

16. **FEW ONLY LIGHTNING ARRESTORS.** For television; can be mounted either inside or outside house. Suitable for all types of lead, flat ribbon, open line or coaxial. All mounting screws, etc., supplied. **Price only 5/6 each.**

17. **FILTER CHOKE,** 1 Henry, 300ma. Brand new and packaged, built especially for use in TV sets. Worth 30/. **Our price, only 15/- each.**

18. **SINGLE CRYSTAL EARPIECES,** ideal for crystal sets, etc. **Price, only 10/-.**

19. **SINGLE MAGNETIC EARPIECES,** as used in Japanese Transistor Portables, etc. Low Impedance. **Price, only 12/6 each.**

20. **CRYSTAL MICROPHONES.** Frequency response 100 to 8000 C.P.S. Chromeplated finish with 6ft cable. A very popular job, new and boxed. **Price only 25/- ea.**

21. **PRIZE MODEL BM3,** Crystal Microphone Frequency response 100-8000 CPS with on-off switch. Can be used on stand or for hand use. Excellent appearance. **Only 75/ ea.**

22. **TWIN TRIMMER CONDENSERS**—100PF capacity on Trolutol base only 1/ ea.

23. **TYPE 108 CHOKES** 40mA. Ideal for small Mantel Sets, Car Radios or Vibrator Sets. **Price only 3/9 ea.**

24. **ALUMINIUM CHASSIS**—Undrilled.

| | | | |
|---|---|---|---|
| 5 x 3 x 2 .. | 7/8 | 13 x 7 x 2½, | 15/4 |
| 6 x 4 x 2 .. | 8/7 | 13 x 10 x 2½, | 18/ |
| 8 x 5 x 2½, | 10/4 | 17 x 8 x 3, | 22/6 |
| 10 x 6 x 2½, | 12/7 | 17 x 10 x 3, | 25/6 |
| 11 x 8 x 2½, | 15/4 | 17 x 12 x 3, | 27/ |

25. **MINIATURE PHONE PLUGS** as used in Japanese Transistor Portables, etc. **Only 1/6 ea.**

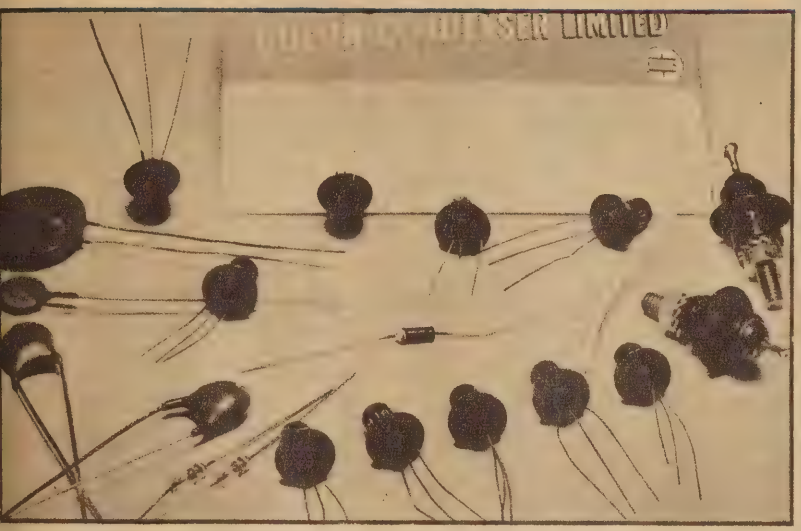
26. **MINIATURE PHONE JACKS,** closed circuit type match above. **Only 1/6 ea.**

27. **21-inch TELEVISION MASKS** in thick grey plastic guaranteed perfect. **Only 5/ each.**

**547 ELIZABETH STREET, MELBOURNE —— Phone FY0271**

***BRANCHES THROUGHOUT VICTORIA AND RIVERINA***

# RECENT RELEASES FROM DUCON



Pictured above is a representative selection of recent releases in the semiconductor and allied fields by Ducon Condenser Limited, of Villawood, N.S.W. Manufactured locally, they comprise transistors, germanium diodes and thermistors made under licence from the C.S.F. Company of France, and silicon diodes made under licence from the A. P. Mallory firm in Indianapolis, U.S.A. All should find ready applications in Australian electronics.

AMONG the germanium diodes sent for our inspection was the SFD 108, high reverse resistance signal diode similar to the well-known types OA81, OA85, OA91 and OA95. A matched pair, designated type SFD 110, is intended for ratio detector and similar duty, and is similar to the type 2OA79.

The SFD 106 is a small germanium diode intended as a detector, for use up to 50 Mc. It can be seen in the centre of the above picture.

Among the transistors, there is the SFT 108, a type intended for broadcast converter use, and the SFT 151, an audio- pre-amp type similar to the OC70 and 2N406. In the audio driver field, here is the SFT 153, having high gain, and the SFT 152, an average gain unit similar to the OC71 and 2N408 types.

For audio output use there is the 2xSFT 122, a matched pair giving 500 mW under class B conditions, and similar to the type OC72. The matched pair type 2xSFT 123 is intended for similar use.

The silicon rectifier type 1N2094 is a 750mA, 400 PIV type, similar to the OA210 type. One interesting difference, however, is that it has no provision for attaching additional radiating surface to promote cooling. The SFR 105 is a germanium power diode having a peak current of 15 amps at 25 degrees C.

All inquiries to the Semiconductor Division, Ducon Condenser Pty. Ltd.

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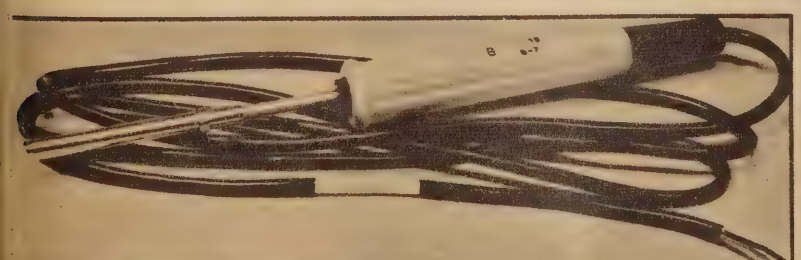

*Pictured above is the "Precision" miniature soldering iron, being distributed in Australia by Messrs J. H. Magrath & Co. Pty. Ltd., of 208 Little Lonsdale St., Melbourne, C1. Two models are currently available, the B6 and B12, for 6 and 12-volt operation and rated at 12 watts. Selling price is 41/3 and spare bits are available at 5/11 each. Measuring just under 7 inches overall, the iron is strongly made and well finished, being weighted so that the tip remains clear of the surface, when the iron is laid on a table. The shaft is of stainless steel and the bit heavily nickel plated.*


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# BOOKS-REVIEWS AND COMMENTS

**"STEREO HANDBOOK." By G. A. Briggs. Hard cover, 146 pages, 9 x 5¼in. Published by Wharfedale Wireless Works Ltd., Bradford, Yorkshire.**

Well known for his professional connection with Wharfedale products and also for his large-scale audio demonstrations, G. A. Briggs has the air of a man who thoroughly enjoys his occupation.

That air is maintained in this new book, the latest of several which have come from his pen. The "how" and "why" of stereo is salted throughout with a good deal of discussion and quip. Designed for readibility, the author says of his book, "it is non-technical throughout and should be easily understood by any reader who, like the author, can count up to 20!"

Of the 15 chapters in the book, the first four are general in character, with the author seeking to sort out some of the confused ideas such as "stereo v. hi-fi," as if the two were inevitable alternatives.

From there on, he progresses in orderly fashion through recording techniques, turntables, pickups, tone arms and stylus problems.

This is followed in turn by amplifiers, loudspeakers, tape systems, room acoustics, concert halls and broadcasting, with a final group of questions and answers. It's all very interesting reading from someone with a wealth of background experience.

Our copy came directly from the author, personally autographed for good measure! (W.N.W.)

★ ★ ★

**"WORLD RADIO, TELEVISION VALVE HANDBOOK." Second edition, published and edited in Denmark by O. Lund Johansen. Stiff paper cover, 225 (approx.) pages 6¼ x 5in.**

Keeping track of valve types always has and probably always will be a major problem for the radio technician or engineer. Reference books which aim to give full information on all types become bulky, costly and often difficult to use.

In this book, the author has sought to compress the information by grouping together valves which have similar electrical properties and which would operate, for example, with common, compromise values of plate, screen and bias voltage — generally within 10 per cent of published values.

To this is added basing data so that the user should be able to employ or to assess working conditions of all types so classified.

Those listed includes valves of Australian, European and American origin, T. R. tubes, diodes and transistors. In all, a lot of useful data is presented in almost pocket-book size.

Our copy from the Technical Book Co., 295 Swanston Street, Melbourne. Price quoted 22/6 plus 1/ postage. (W.N.W.).

**"BALLISTICS AND GUIDED MISSILES." By Adrian Ball. Hard cover, 143 pages, 7½ x 5in. From the "Mechanical Age Library," published by Frederick Muller Ltd., London.**

One might describe the contents of the "Mechanical Age Library" as "popular science in book form." The volumes are intended to present useful information on the various subjects, without seeking to be textbooks.

In this case, the author describes, in order, intercontinental ballistic missiles, intermediate range missiles, ground-to-air and air-launching types. There are chapters on the production of a typical missile, missile ranges and testing centres, and the uses of missiles for war and peace.

Free reference is made throughout to what individual nations have achieved thus far, with appropriate pictures and diagrams.

Dated 1960, the book is quite current though it is a subject on which information will date rapidly.

Our copy came directly from the publishers.

★ ★ ★

**"BASIC CARRIER TELEPHONY." By David Talley, Stiff paper cover, 170 pages, 9 x 6in. Published by John F. Ryder, Inc. New York and Chapman and Hall Ltd., London. Ryder publication No. 258.**

This latest addition to the Ryder library makes liberal use of what the publishers term the "pictured text" technique to illustrate what is admittedly a complex subject. Between one-third and one-half of the total space is occupied by drawings, tables and graphs, all aimed at clarifying the subject matter.

The early chapters review basic telephone systems, then go on to explain the practices and definitions relative to carrier telephony.

Following this, the author delves more deeply into the whole subject, giving detailed attention to circuits, modulators, demodulators, filter networks and switching.

Later chapters deal with two-wire and four-wire systems, with cable carrier practices and radio systems.

In all, the book appeals as a mine of graphically presented information, which should be of great value to anyone seeking knowledge in this specialised field.

Our copy came from the publishers. (W.N.W.)

★ ★ ★

**"TRANSISTORS — THEORY AND PRICTICE," compiled by L. Brock-Nannestad, Electr. Eng. Published by World Publications, Hellerup, Denmark. Stiff paper cover. 64 pages, 8¼ x 5¾in.**

Here is yet another book dealing with transistors, this time from Denmark and carrying the odd misspelt word to indicate its production in (to us) a foreign country.

Though styled as an introduction to transistors, I wouldn't rate it as a book for beginners. The author resorts too frequently and too freely to formulas, graphs and equivalent circuits, which are the language of more mature technicians.

However, for this very reason, the book may be considered well worth its modest purchase price by those who have grown accustomed to such things in valve literature.

A little more than half the book is given to basic theory, followed by a somewhat shorter section on typical circuit applications and a final 16 pages of transistor data.

Our copy from The Technical Book Co., 295 Swanston Street, Melbourne. Price quoted 16/ plus 1/ postage. (W.N.W.).

★ ★ ★

**"HOW TO IMPROVE YOUR SHORT-WAVE RECEPTION," by John Schroder. Stiff paper cover, 82 pages, 8¼ x 5¾in. Published by World Publications, Hellerup, Denmark.**

This book, translated into English from the original text, is a reminder of the days when listening to the short waves was both a popular pastime and a major technical activity.

It is a book purely and simply for short-wave enthusiasts.

After a general introductory chapter, the next three are devoted to constructional projects, with a couple of regenerative receivers, a couple of superhets, and a couple of converters.

Chapter five deals with designing and winding your own coils, chapter six explains various refinements to short-wave receivers, while chapter seven discusses aerials and aerial tuning units.

Some of the terms and circuits may be a trifle strange at first encounter to local readers but will present no lasting problem.

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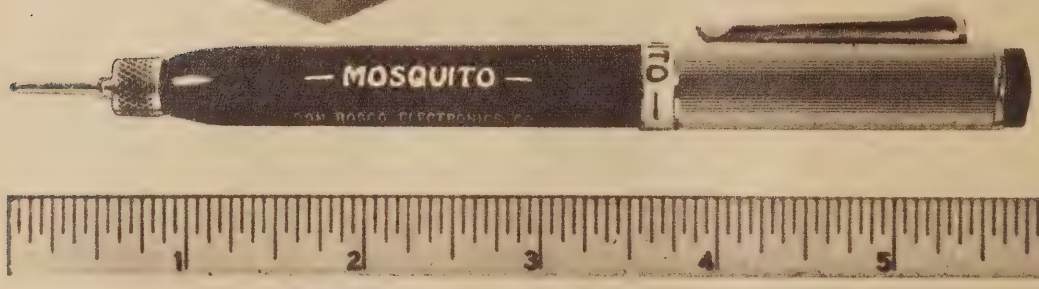


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# BOOK REVIEW

**PROGRESS IN SEMI-CONDUCTORS, No. 4, edited by A. F. Gibson, F. A. Kroger, R. E. Burgess. Hard cloth cover, 291 pages, 10 x 6in. Published 1960 by Heywood and Company, London.**

This is the fourth in a series of books eased annually by the publishers der the same title.

It is really a group of eight engineer- papers, commissioned from authors international standing and intended to ng together the main facets of new earch in this rapidly expanding field.

The papers rely heavily on advanced sics, chemistry and mathematics and l be appreciated in full only by those ving an adequate engineering back- und.

Representing research in U.S.A., Bri- n, U.S.S.R., Holland, Japan and Ger- ny, the authors all have doctorates.

Titles of the papers are as follows:—

'Negative Effective Masses in Semi- ductors."

'Oxidation Phenomena in Germanium faces."

'Theory of Avalanche Multiplication Non-Polar Semi-conductors."

'Internal Field Emission."

'Noise in Semi-conductors."

'Electrical Effects of Dislocations in ni-conductors."

'Dielectric Properties of Solids in Re- on to Imperfections."

'Non-Crystalline Electronic Semi-con- tors."

Our copy from the Technical Book al Magazine Co. Pty. Ltd., 295-299 Sanston Street, Melbourne. Austra- n price 90/9, postage 2/6. (W.N.W.)

★ ★ ★

**"HOW TO BUILD TV ANTENNAS," by F. Rydstrom, O. Engeltoft and J. Fialla. Stiff paper cover. 88 pages 8¼ x 5¾in. Published by World Publications, Helerup, Denmark.**

The casual observer may well see the e and price of this book, buy one and n off to build himself a TV antenna t night. He'd probably be dis- ointed.

The main reason for this remark is t the dimensions given are in centi- res and frequencies that relate to ropean and American channel alloca- s — not Australian. Data for Aus- ian conditions would have to be de- d from the basic information or gain- by interpolation.

At the same time, however, the book tains a fair amount of basic informa- for the student and may be worth modest purchase price on that score.

The subjects covered include wave pro- ation, TV and FM aerials, feeders, ching and matching transformers, nna amplifiers, community antennas. ltiple receivers, units, definitions and es. A possible criticism for local ditions is that not enough emphasis aid on the design of multi-channel als.

ur copy from the Technical Book 295 Swanston Street, Melbourne. e quoted 22/6, plus 1/ postage. N.W.).

**"BRITISH SEMICONDUCTOR GUIDE, 1960." — Edited by C. C. Gee and C. A. Marshall, B.Sc., A.M.I.E.E. Stiff paper cover, 86 pages 11¼ x 8¾in.**

This is very much a specialised publication, which will find its greatest use in laboratories and reference libraries.

It is exactly what its title implies — a guide to no less than 963 semiconductor devices currently available from British manufacturers. As such, it is probably more complete and more thorough than any similar information appearing in "universal" data books.

Unfortunately, for those with poor eyesight, the information is presented in as small a type as we have ever encountered in a technical publication. It is strangely out of keeping with the array of manufacturers' display advertising which occupies the front and back of the journal — and about half of the total space.

Two general technical articles on semiconductors precede the data list.

Our copy from The Technical Book Co., 295 Swanston Street, Melbourne. Price quoted 9/6 plus 1/3 postage.

★ ★ ★

**"TRANSISTORS, CIRCUITS AND SERVICING" (Second Edition), by B. R. A. Bettridge, M.Brit., I.R.E. Stiff paper cover, 27 pages 9 x 6 inches. Published by Trader Publishing Company, London.**

This little book has evidently proved very popular, having exhausted three printings and run to a second edition since 1957.

Written in plain "radio language" and without mathematics, it is intended primarily as a simple introduction to the subject for servicemen and enthusiasts of comparable technical knowledge.

After an introductory chapter explaining what a transistor is and does, the author discusses the transistor in common base and then common emitter connection. Then follow chapters on the transistor as a low frequency amplifier, typical transistor receiver circuits and, finally, some general servicing notes.

There is a limit to what can be put into 27 pages but then, of course, this isn't a costly book, selling for only 3/ in England. (Our copy from the publishers.)


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# DISTORTION IN A-F AMPLIFIERS

**This is the second of two articles published by Sylvania Electric Products Inc., concerning the testing of audio amplifiers. In particular it has something to say about intermodulation distortion. It should be read in conjunction with the first article, published in the May, 1960 issue.**

***By W. J. Sember***

THE basic instrument set-up necessary to service audio amplifiers is shown in Figure 1. An oscilloscope is employed mainly because distortion and hum on an audio wave can be assessed with much greater accuracy than by simply relying on the ear.

An audio generator is used to provide a sine-wave signal to the amplifier, and the audio power from the output transformer is dissipated in a load resistor. The voltage across this resistor is used to provide the vertical display on the oscilloscope, and the output wave thus obtained is used to evaluate the amplifier performance.

A load resistor should always be used on a power amplifier when the speakers are disconnected, to retain correct operating conditions and to prevent the development of high peak plate voltages with signal.

## LOAD VALUE

The ohmic value of the load resistor should equal the nominal impedance of the speaker it replaces. If the value of the speaker impedance for a particular amplifier is not known, a value of five to eight ohms is a good choice. In any case, this resistor should have a sufficient wattage rating to prevent excessive heating during testing.

An AC VTVM should be used for determining the power level at which the tests are being conducted using the relationship: Po equals V squared/R where:

V equals RMS voltage across the load
R equals load resistor in ohms.

A typical output waveshape from the circuit shown in Figure 1 is presented in

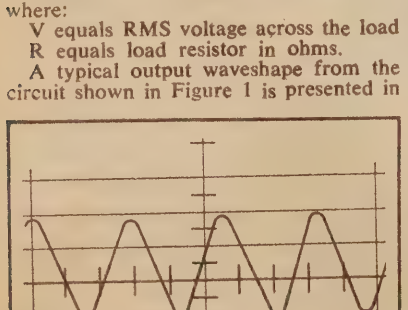


***Fig. 2. Typical sine-wave output waveshape from the circuit shown in fig. 1. No appreciable distortion is evident.***

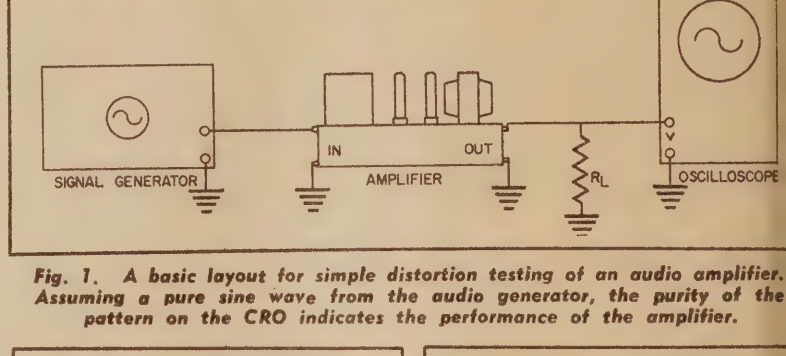



***Fig. 1. A basic layout for simple distortion testing of an audio amplifier. Assuming a pure sine wave from the audio generator, the purity of the pattern on the CRO indicates the performance of the amplifier.***

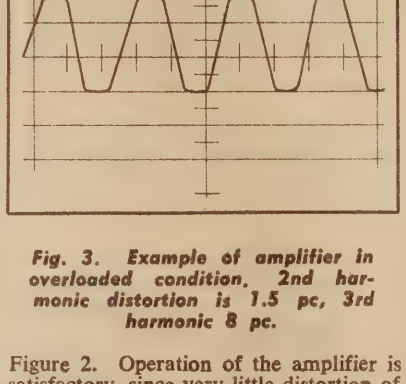


***Fig. 3. Example of amplifier in overloaded condition. 2nd harmonic distortion is 1.5 pc, 3rd harmonic 8 pc.***

Figure 2. Operation of the amplifier is satisfactory, since very little distortion of the sine-wave is evident.

Figure 3 shows the output waveshape of a push-pull amplifier which is operating in the overload or clipping region. The flattening which is evident on the peaks of the signal indicates a high third harmonic content.

Very little distortion is evident near the zero axis of the sine-wave; thus, second harmonic content is low.

Actual measured percentages of distortion on this wave were eight per cent third harmonic and 1.5 per cent second harmonic distortion.

## EXAMPLE

A pair of valves in push-pull which show high second harmonic distortion is shown in Figure 4. In this case, the amplifier is severely over-driven and the bias on the two output valves has been upset. The transfer characteristic of this pair of valves would look like that shown in Figure 5.

The disturbed bias is evidenced as distortion at the cross-over point or the approximate zero axis of the sine-wave. Measured distortion of this pair of valves was 5.7 per cent second harmonic and 13.7 per cent third harmonic distortion. The standard test frequency of 1,000 cycles was used to obtain these figures.

Harmonic distortion may be described by the average listener in a great variety of ways. That is, since harmonics are overtones, they may or may not be ob-

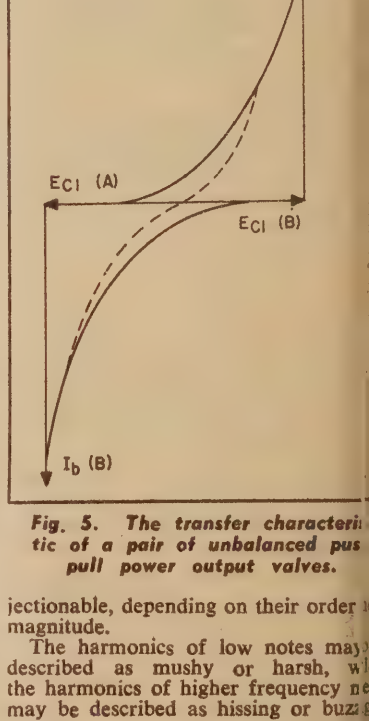



***Fig. 5. The transfer characteri tic of a pair of unbalanced pus pull power output valves.***

jectionable, depending on their order magnitude.

The harmonics of low notes may described as mushy or harsh, w the harmonics of higher frequency n may be described as hissing or buzz

The frequency characteristics of amplifier will also affect the produc of harmonics; for example, an am fier with a large amount of bass b will tend to nullify the effects of monics of low frequency notes, and versely, an amplifier with treble b will amplify the effects of harmonic mid and high frequency tones.

In addition to checking mid-r distortion, it is a good idea to eval the amplifier at the low and high quency ends of the audio spectrum.

Intermodulation distortion may checked in the service shop by usin method shown in Figure 6. The two nals are added without intermodul by the balanced bridge circuit.

An audio transformer is used as leg of the bridge to provide the s for the amplifier. This transfo

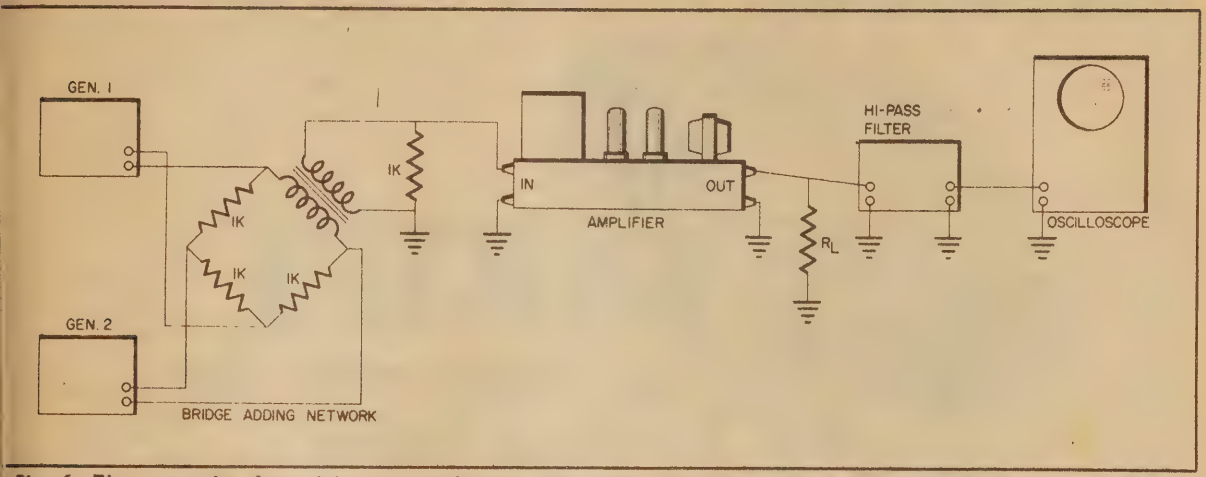



***Fig. 6. The set-up for determining intermodulation distortion. The filter in the output stage should remove any low frequency signal other than that which has modulated the high frequency signal. This represents intermodulation distorition.***

ould have a 1:1 ratio, and it should
e of relatively good quality to prevent
termodulation.

The resistors in the legs of the bridge
ould be as nearly matched as is pos-
ble to prevent any possibility of interac-
on between the generators.

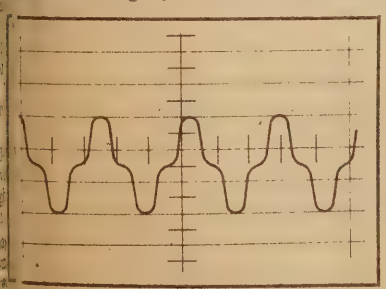
If only one audio generator is avail-
le, the AC mains may be used to pro-
de the low frequency tone if suitable
olation and a variable voltage is pro-
ded.

As described in Part 1, the high pass
ter is used to remove the low fre-
ency tone from the output wave to
event it from obscuring the oscillo-
ope pattern.

One type of high pass filter which
ay be used for this application is shown
Figure 7. This consists of two
mple "L" type filters in parallel to
ovide an attenuation of 12db per
tave. The circuit constants shown
re chosen to provide optimum results
hen the test frequencies for the I.M.
easurement are 60 and 6,000 cycles.
is same filter may be used for any
lue of high frequency above 6,000
cles.

To perform the actual measurement,
e voltage of the low frequency note
adjusted to be four (4) times the volt-
e of the high frequency at the input
the amplifier.

The oscilloscope is then synchronised
the low frequency of the modulation
velope, and patterns such as those
tched in Figure 8 will be observed.



***ig. 4. The effects of overload
nd serious unbalance in output
alves. 2nd harmonic, 5.7 pc.;
3rd harmonic, 13.7 pc.***

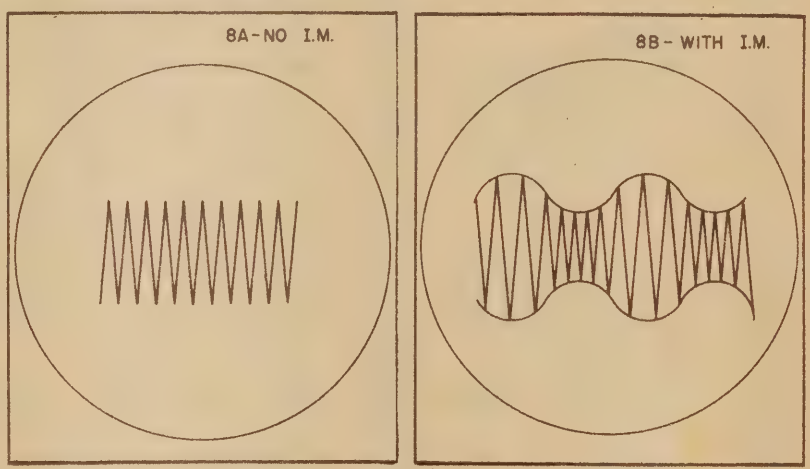



***Fig. 8A (left) is a pattern of the high frequency signal without any sign of intermodulation. 8B (right) shows substantial low frequency component superimposed.***

These will be recognised as the normal modulation envelope that is obtained from a modulated RF wave.

The depth of the modulation provides an indication of the amount of intermodulation which is present within the amplifier. The pattern shown in Figure 8A indicates no intermodulation is present; Figure 8b shows the pattern observed when intermodulation is present.

LeBell has derived a quantitative method for determining the amount of

☆

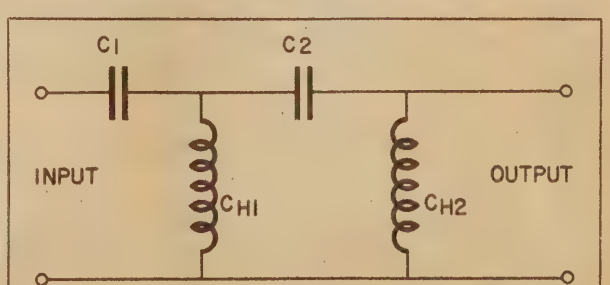
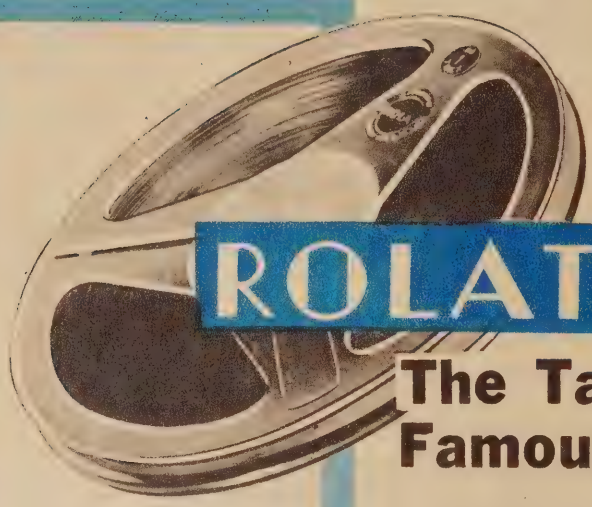



***Fig. 7. The high pass filter circuit used to remove the low frequency signal. Slope of the filter is 12db per octave. It is really two simple "L" filters combined.***

C1, C2 = 2.0 µfd, 150 volt capacitor.
CHI, CH2 = 40 Mh, 150 mA choke
For best performance, the filter should be shielded.

☆



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## The Tape with the Famous Name

If you're serious about tape recording, you'll appreciate both the fidelity and the frequency range of the sound you can record on Rolatape. Manufactured by an organization with more than 30 years' experience in the field of sound reproduction, Rolatape is not merely another recording tape — it is the best you can buy.

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Rolatape is available on a range of standard spool sizes and in lengths from 225 to 3,600 feet.

Two types of Premium-Quality Rolatape are currently available — the standard 1½ mil PVC-based tape used for most recording applications, and the 1 mil Polyester base which provides 50% more recording time per reel.

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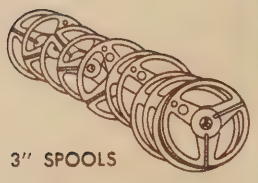

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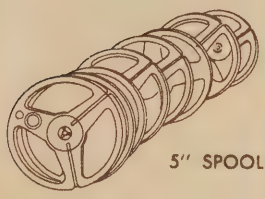

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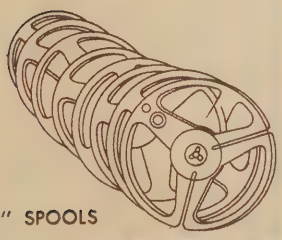

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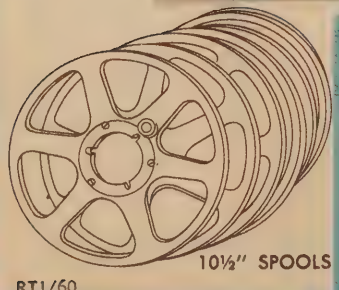

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.M. present on a pattern such as that hown in Figure 8, by correlating the epth of the modulation, or the depth f the modulation "notch," with meas-red quantities of I.M. distortion.

The method of obtaining the per cent notch depth" is shown in Figure 9; and his notch depth is related to the I.M. s shown in Figure 9.

It should be noted that the curve is straight line with a 1:5 slope in the egion below 50 per cent notch depth. hus, one-fifth of the notch depth is the pproximate amount of I.M. present up o the point where the notch is one-alf the depth of the modulated wave.

LeBell's method is said to give results hich are approximately equal to those btained by the 4:1 method using the MS sum of the individual intermodula-on products.

## OSSIBLE CONFUSION

Caution should be exercised when us-ng the power line as the source of the ow frequency 60 cycle note for the I.M. easurement. It should be remembered hat any hum in the amplifier will in-rease the apparent percentage of I.M. nce the hum will make the wave ap-ear to have a higher 60 cycle compon-nt.

The circuit shown in Figure 1 may e used to check amplifier hum by short-ng the input terminals of the ampli-er being tested and observing the scope or possible hum output.

Intermodulation distortion will prob-bly be described by the set owner as a uzzing or harsh sound from the ampli-

# "NOTCH DEPTH" CALCULATIONS

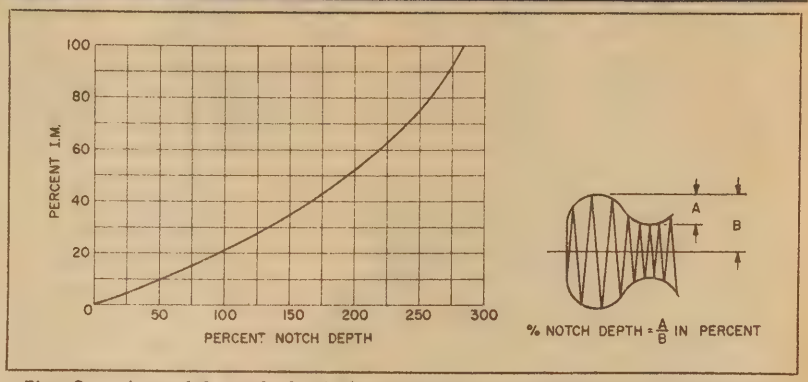


*Fig. 9. A useful method of determining intermodulation by measuring notch depth. Percentage A/B is transferred to the graph and converted to percentage of intermodulation distortion.*

fier, seemingly "on top" of the program material.

The causes of Harmonic and Intermodulation Distortion in amplifiers are directly related; for when one is present the other usually occurs. While aging valves should be suspected, there are many other sources within the amplifier which may cause distortion to increase.

Leaky coupling capacitors, which put a positive bias on the grid of the following stage, will cause clipping on the peaks of the signal. Grid emission in any stage will cause this same symptom.

Changes in the values of plate and cathode resistors in the amplifier may also cause excessive distortion. Low B plus voltage and changes in the screen voltage on output pentodes will upset balance and produce excessive distortion.


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# ABOUT THIS DECIMAL BUSINESS

(Continued from Page 19)

roposition, against the background of xpenditure exceeding £30 million:

) It is characteristic of man that when faced with a burdensome task he invents a means of making it lighter, and we have done just that with our arithmetic. We have surrounded ourselves with bookkeeping machines, cash registers, adding machines, computing petrol pumps, computing scales, ready reckoners, slide rules, log tables, and so on until there is very little hard labour left. It is not easy to see how a different coinage could effect a wholesale saving of effort.

) A change-over, at all events, would be justified only if it helped the people who do sums all the time. Such a costly measure is not justified to help the person who never tackles anything more complicated than the price of three beers.

But the other people, the kind who e by arithmetic, don't need help. Not that price anyway. They adopt labour-ving devices, and in addition, soon be-me so adept that one coinage is much same as another.

For my own part, for instance, I be-e I can do the traditional sums above th the possible exception of long divi-s n) just as quickly as the decimal.

Please don't disturb the coinage on my ount!


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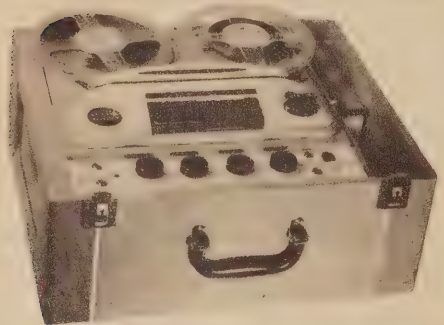

**THE COMPLETE UNIT IS SUPPLIED IN ATTRACTIVE AND DURABLE TWO-TONE COVERED CASE COMPLETE WITH ACOS MICROPHONE AND FITTED WITH DUAL ROLA SPEAKERS.**

The amplifier incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R. standards giving perfect reproduction from recorded tapes. Outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with perspex dress plate to match deck. Output: 4 watts can be used as straight amplifier if required.

**Model TR2 incorporates the new Collaro "Studio" Deck which features:—**

- **High Fidelity. Frequency response 40 to 12,000 cycles at 7½in per second.**
- **Three 4-pole shielded motors.**
- **Three speeds, 1-7/8, 3¾ and 7½.**
- **Fast forward and rewind, 1200 ft in 65 seconds.**
- **Two track.**
- **Light piano key controls.**
- **PAUSE CONTROL**
  This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between music selections. Control will only work whilst it is held in position.
- **TAPE MEASURE AND CALIBRATING DEVICE**
  The three digit counter makes the location of any recorded passage the simple of operations.
- **TRANSCRIPTION TECHNIQUE**
  A large diameter flywheel with ground and lapped steel shaft running on ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter at less than 0.15 per cent at 7½in per second.

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**MODEL TR3.** For this recorder we have chosen the new English B.S.R. deck. This is a two track single speed unit (3¾in per second) giving two hours' playing on a 5¾in long play tape or one hour on a standard 5in tape.

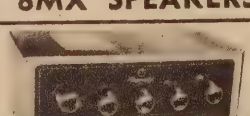
Automatic locking device prevents accidental erasure. Frequency response 60 to 8,000 cycles.

The five valve amplifier including "magic eye" level indicator has two inputs, for microphone, radio, or pick-up; and outputs for external amplifier or speaker, equalised to C.C.R. standards. Can be used as straight amplifier if required. Output 3 watts.

The recorder is fitted in attractive two-tone case with dual speakers and microphone.

Overall dimensions 14in x 10in x 6½in. Weight 26lb.

## UNIT STEREO PLAYMASTER AMPLIFIER No. 2 WITH RADIO TUNER AND TWO ROLA 8MX SPEAKERS



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o pair of M.S.P. Jensen speakers or two Rola 12in dual coned speakers supplied. Power output 10 watts per channel (20 watts). Frequency ponse of amplifier 40 to 15,000 cycles.

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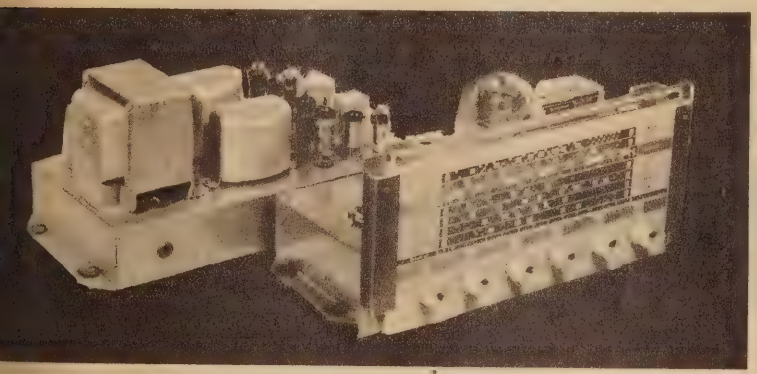

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**EW:**
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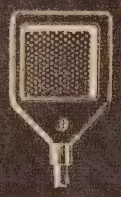
# ACOS MICROPHONES



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Desk stand extra.

**CRYSTAL MICROPHONE MIC40**
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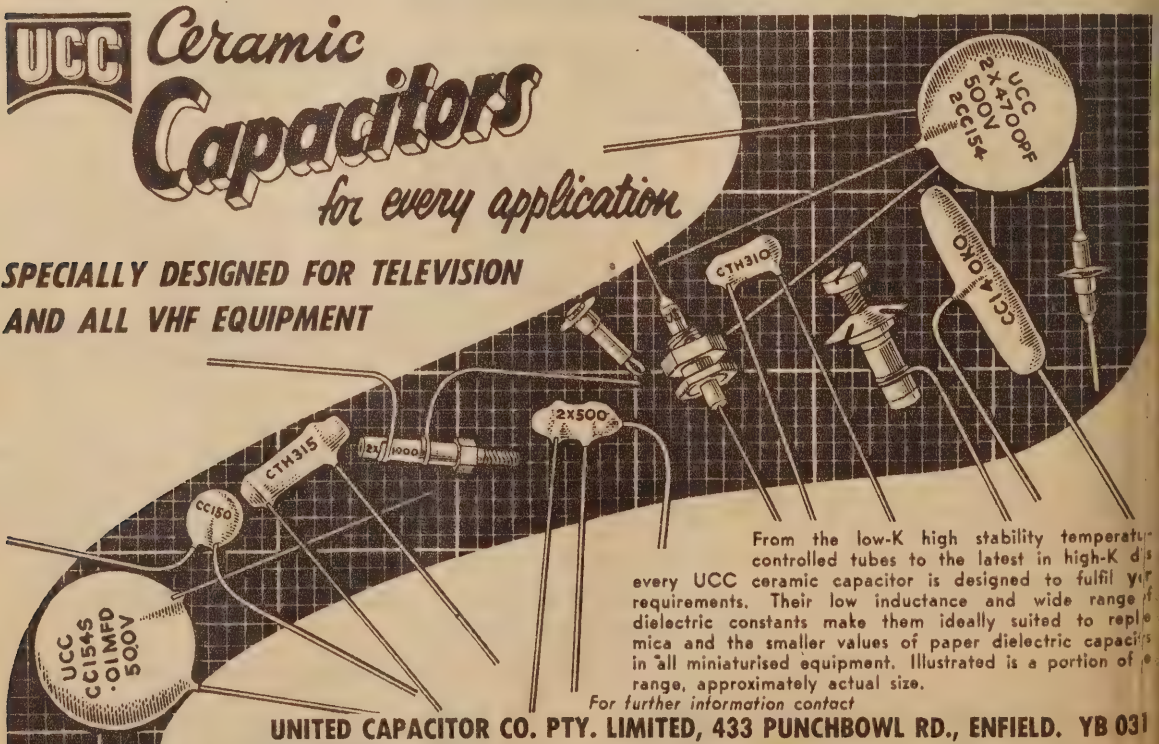


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# CALIBRATING YOUR OSCILLATOR

**Here are calibration details of the Compact Modulated Oscillator described in the September issue. Anumber of calibration methods are given, to enable most constructors of this instrument to calibrate it accurately and conventiently at home. There is also a dial scale which should suit this circuit and make calibration a good deal easier, as well as improving the appearance.**

OSSIBLY the easiest way of calibrating an instrument of this type inves the use of a Heterodyne Frency Meter. A typical meter of this e, the well-known BC 221, which has en available quite freely ex-disposals, very suitable for the job. Other instrunts, such as that made by A.W.A., , of course, equally suitable.

A normal superhet-type signal tracer, ich is a somewhat similar instrument, also be used in the same manner.

The procedure is this: The output of oscillator is coupled loosely into the quency meter. This can be done by nnecting them via a small capacitor of 10 pF, or by means of a "pick-up ." The latter may consist of two or ee turns of wire connected to the frency meter input terminals and placed se to the oscillator circuitry.

The dial of the frequency meter is n manipulated until its indicating de- (meter or phones) registers that it uning to the oscillator. The frequency ter should then be turned to lower quencies than that indicated, to make e that it is the fundamental frequency the oscillator which is being tuned.

The rule here is to find the lowest quency component of the oscillator put signal—this will be the fundantal frequency. When it is established t the fundamental is the one being ed, the dial can then be read to ascer the correct frequency.

## OOD RECEIVER

ncidentally, a good receiver can be d in this way to check the frequency the oscillator. Using the broadcast ions as checkpoints for the dial of receiver, the receiver can be tuned he oscillator frequency and used as rt of wavemeter. (For those unsure he broadcast station frequency allo-ns, we published a table in the ember, 1959, issue.)

hus, using the broadcast band of a al receiver, the 470 Kc to 1500 Kc l can be calibrated on fundamentals, the lower band calibrated by reading second harmonic and dividing the ing by two.

the receiver has a short-wave band, can be used to calibrate the higher ency bands, either by identifying fundamental or by noting the frcy separation of the harmonics every harmonic is separated from eighbour by the fundamental frcy). The short-wave calibrations of eceiver may be checked by means he American Standards station /, or similar frequency standards.

other convenient way of calibrating e scillator is the method using Lissa- Figures. This method is probably iar to many readers, and involves e e of a CRO with a reasonable hori- l amplifier. The procedure is to feed the output of the oscillator to one set of plates, say the vertical plates via the vertical amplifier, and the output of a standard Signal Generator or similar instrument to the other set, via the horizontal amplifier.

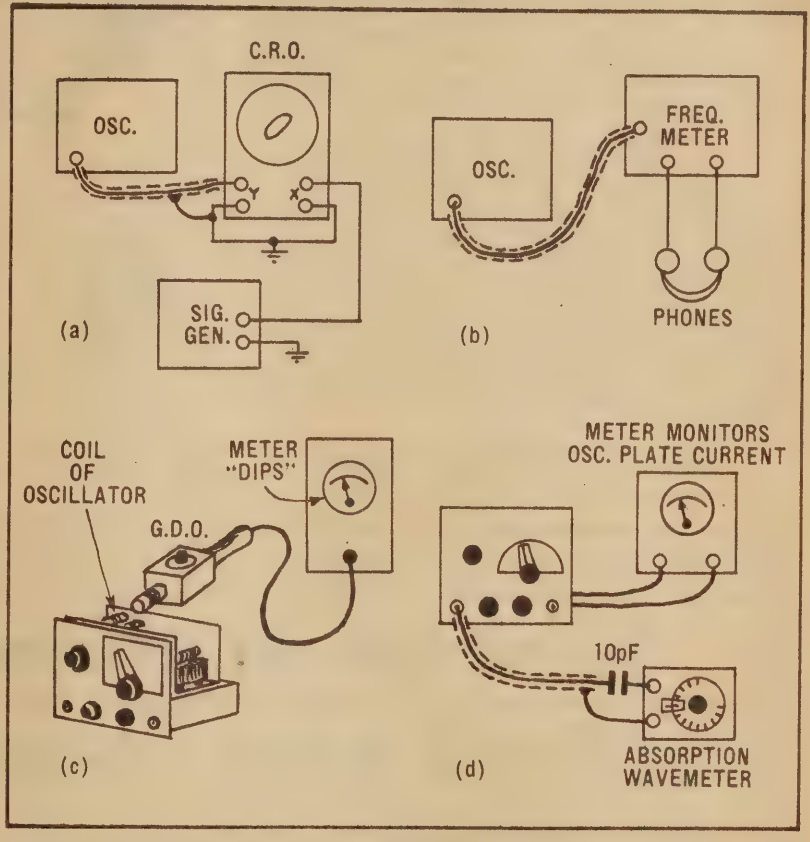


***Figure 1. Here are four of the most popular methods used for calibration of RF oscillators. (a) is the Lissajous Figure method, useful for the lower bands only. (b) shows the Frequency Meter method. (c) shows the use of the Grid-Dip Oscillator, and (d) illustrates the use of the absorption wavemeter.***

## LISSAJOUS FIGURES

If the two frequencies have no particular relationship to one another, all that will be visible is a bright rectangle (or square, depending on the gains of the two amplifiers) on the screen. If there is a reasonably simple relationship between the two frequencies, however, the shape will resolve into one of the easily identified Lissajous Figures.

The figure pattern will not stay stationary, due to phase changes, but will appear to rotate.

The simplest pattern is obtained when two frequencies are identical. This is the circle or ellipse, depending on the amplifier gains and the instantaneous phase. Usually, it will seem to be rolling around like a hoop at 45 degrees to the horizontal.

If one frequency is twice the other, a figure-eight pattern will be obtained either upright or on its side, depending on which signal is the higher frequency. If the signal on the vertical plates is twice that on the horizontal plates, the eight will be on its side, and vice-versa.

For a more complete explanation of these figures, refer to the second article on the "Simple Audio Oscillator" of May, 1960.

It is obvious that this method would allow easy calibration of the modulated oscillator. However, it is only suitable for the lower frequency bands, since the amplifiers of the CRO have a limited bandwidth. The more expensive the instrument, of course, the better the bandwidth (usually), and the further up in frequency one may go.

*Knowledge That Has Endured With The Pyramids*

WHENCE came the knowledge that built the Pyramids and the mighty Temples of the Pharaohs? Civilization began in the Nile Valley centuries ago. Where did its first builders acquire their astounding wisdom that started man on his upward climb? Beginning with naught they overcame nature's forces and gave the world its first sciences and arts. Did their knowledge come from a race now submerged beneath the sea, or were they touched with Infinite inspiration? From what concealed source came the wisdom that produced such characters as Amenhotep IV, Leonardo da Vinci, Isaac Newton, and a host of others?

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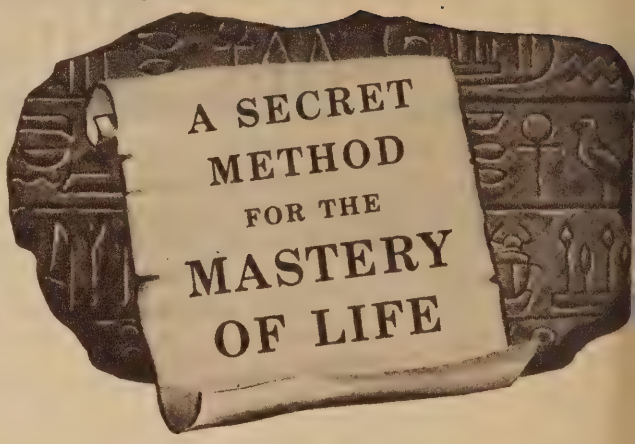


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A simple and quite popular method of oscillator calibration is by using an absorption wavemeter. This is usually a tuned circuit (calibrated previously), and some sort of detector, possibly a sensitive rectifier-type moving coil meter. Operation is simple—it is merely tuned until an output is registered.

Another type of wavemeter is solely a tuned circuit. When using a unit of this type, one has to connect into the oscillator under test. It is usual to connect a current meter in series with the oscillator valve, to monitor its plate current.

## COUPLED TO OSCILLATOR

With the oscillator in operation, the wavemeter is coupled into the oscillator. This is done, as before, by placing the wavemeter coil close to the oscillator coil, or by coupling it via a small capacitor to the output terminal, the other connection going to earth. The wavemeter is then tuned until the plate current of the oscillator rises sharply in a "dip." When the current peaks, the wavemeter is tuned to the oscillator frequency, and is tending to load the valve out of oscillation.

A point to remember if you are using this method and coupling the wavemeter capacitively to the oscillator output is to have the oscillator output attenuator set for maximum output. This provides closer coupling between the two units and allows the wavemeter to have a more noticeable effect on the oscillator activity.

An alternative to monitoring the grid current is to monitor the grid current of the oscillator. This passes through a minimum or "dip" when the wavemeter is tuned to the oscillator frequency. However, with this particular oscillator, it is rather inconvenient to connect into the grid circuit (at the usual place of the lower end of the grid leak), this is not as preferable as plate current metering.

Speaking of grid current monitoring brings us to another popular method of oscillator calibration. This consists of finding the resonant frequency of the oscillator tuned circuit using a Grid-Dip Oscillator. This is done with the oscillator itself turned off. (After having made sure, of course, that the oscillator is indeed functioning on that band! One can sometimes be tricked.)

The Grid-Dip Oscillator is merely a small oscillator whose grid current is monitored (either using a magic eye or a meter), and whose tuning coil may be loosely inductively coupled into other tuned circuits. The operating procedure is precisely the converse of that using the absorption wavemeter.

## TUNED FOR DIP

Thus the G.D. Oscillator is tuned until its frequency coincides with the resonant frequency of the test circuit (in our case, the oscillator tank circuit). The grid current will then show a dip, indicating the sympathetic resonance. Thus, the frequency of the oscillator under test is found, since it must oscillate at the resonant frequency of its tuning circuit.

Until now, we have been discussing merely the means of determining the frequency of oscillation of the oscillator. Obviously, this is all the information needed if one is going to make up the dial scale on the spot. However, many people will wish to save calibration time (and perhaps improve the appearance of the finished unit) by using a ready-made dial scale.

To facilitate this, we have reproduced on these pages a full-scale replica of the prototype scale. This can be cut out and pasted on to the front panel of the oscillator, used merely as a guide, or perhaps photo-copied. For interested readers, we hope to have available eventually glossy prints, also full size. Instrument case manufacturers will probably be able to supply engraved scales on their cases in due course.

Naturally, due to differences in components, layout, position of coil slugs, adjustment of trimmers and other factors, the ready-made scale will not accurately indicate the oscillator frequency automatically. However, using any of the abovementioned calibration procedures, and manipulating both the coil slugs and the trimmers, it is possible to align the oscillator and scale quite accurately.

The procedure is this: The oscillator tuning pointer is set to a point near the low-frequency end of each band, at a convenient marking. The calibrating equipment is then adjusted so that it is set at the dial frequency. The oscillator coil slug in question is then adjusted until the actual oscillator frequency becomes that indicated.

## TRIMMER AT HIGH END

The dial pointer is then turned to a marking on the upper end of the scale, and the calibrating equipment adjusted to the new frequency. LEAVING THE OSCILLATOR COIL SLUG ALONE, the frequency of the oscillator is corrected with the appropriate TRIMMER. Naturally, this may alter slightly the calibration at the low frequency end of the band, so the lower frequency is retuned and the coil slug touched up.

This, in turn, will affect the high end, so the trimmer is readjusted at the upper end of the dial. In practice, you will find that this interaction is not too serious, and "touching up" twice at each end is seldom necessary.

Obviously, this procedure must be carried out for each band in turn. However, it proves substantially quicker and easier than starting from scratch with a blank scale.

(Note: In calibrating the lowest band of the prototype unit, we found it necessary to wire a fixed ceramic capacitor of 33 pF from the grid end of the coil to earth, to ensure reliable oscillation. This will, naturally, depend on the coil used for this band. However, it will affect the calibration of the lowest band, so we suggest readers who intend using the ready-made scale wire it in place, for ease of calibration.)

This completes the description of our latest oscillator, which should find many uses in the home service workshop.

## TYPICAL LISSAJOUS PATTERNS

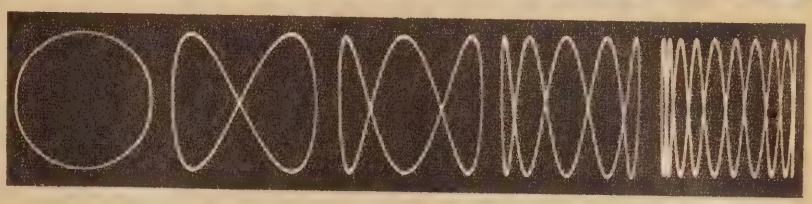


*Figure 2. Here are some the Lissajous figures corresponding to various frequency ratios. At the extreme left is the pattern for a 1:1 ratio, while the next shows a ratio of 2:1 (vertical signal higher in freq.). The following patterns are those for ratios of 3:1, 5:1 and 10:1. Generally, the first two are the only ones suitable for comparison of RF signals, the other patterns proving too difficult to read.*

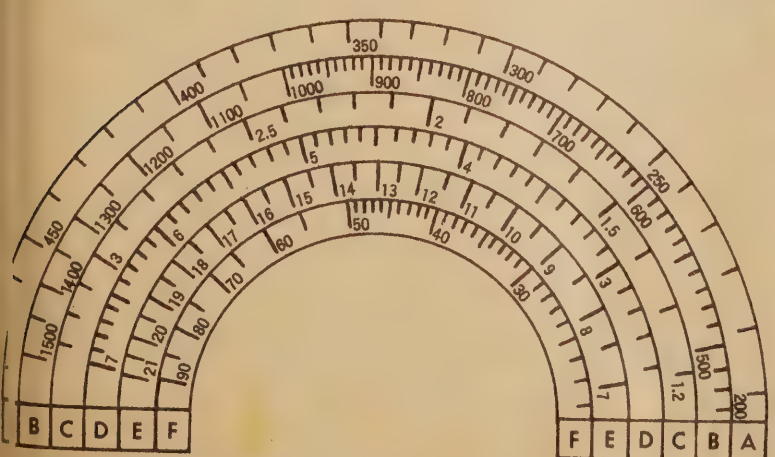



*Figure 3. Here is the final dial scale of the prototype oscillator, reproduced actual size. Glossy prints of this scale will be available shortly via the Query Service.*

# A COURSE IN TELEVISION

## PART 37 — GENERATING THE EHT VOLTAGE

**This article is devoted to a discussion of the extra high tension (EHT) supply necessary to operate the picture tube. While prime attention is given to the modern "flyback" type supply, reference is made to the 50-cycle and RF type supplies used in earlier receivers.**

APART from the smallest types as, for example, the 1in 913, cathode-ray tubes need DC voltages well in excess of the normal HT supply to accelerate electrons from the gun structure to the fluorescent screen. The special high-voltage supply required by the tube is commonly referred to, nowadays, as the EHT supply—an abbreviation of extra high tension.

In general, the order of EHT voltage required by cathode-ray tubes increases with their screen area. The higher voltage is necessary to provide an electron beam of sufficient density and velocity to illuminate the larger screen for adequate television presentation.

For oscillographic work an EHT voltage of about 1.5 to 2KV is normally sufficient. For early, small-screen receivers, figures of 5 to 9 KV were required. Modern 17- and 21-inch receivers, of the type currently used in Australia, operate with an EHT potential in the range 14 to 18 KV.

Although the voltage required is high, the current drain of a television tube is quite low, being reckoned in microamps, but varying greatly with the setting of the Brightness control.

Early television practice was to derive the necessary EHT from a rectifier and a high-voltage low-current winding on the power transformer, much as is done still in test oscilloscopes. Alternatively, the requisite voltage was sometimes derived from a somewhat lower voltage winding on the transformer, using a series of metallic rectifiers and capacitors in a voltage-multiplying circuit.

Because of the low ripple frequency—50 cps—any EHT supply derived from the power mains requires capacitors of relatively large value for filtering purposes. Apart from their cost and bulk these can present a very real shock hazard, by reason of the total energy which can be stored therein.

It has been suggested that the energy stored in an EHT filter circuit should not exceed 1 joule, or 1 watt-second. This is equal to C times V-squared over 2, where C is in farads and V is in volts.

This means that, with an EHT of 15KV, the total filter capacitance in circuit should not exceed 0.01mfd and ideally, it should be a good deal less than this. Whether adequate filtering can be obtained at 50cps with capacitors of such an order is open to question.

A further difficulty is that a 50-cycle EHT supply is completely independent of the deflection system. It would thus be possible for the deflection to fail and for the beam to rest, still at full brilliance, on one spot in the centre of the screen.

As an alternative to the mains-derived system, so-called RF type supplies enjoyed considerable popularity for a period, being still used freely in models high-performance oscilloscopes.

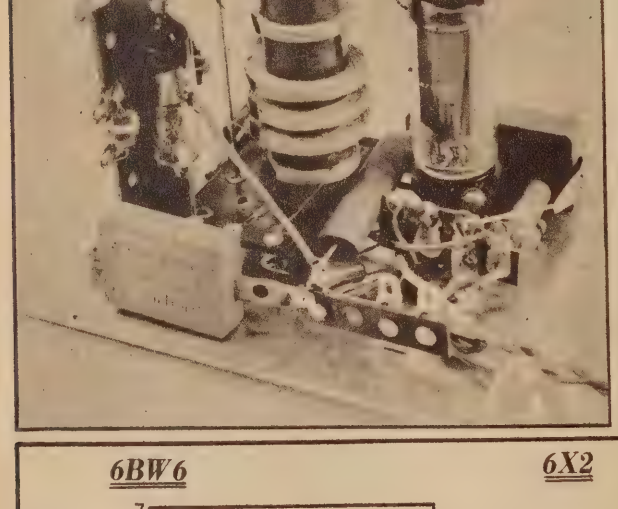
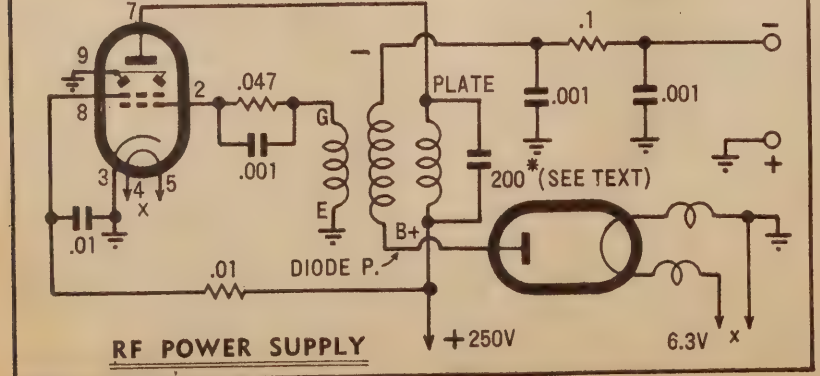


*Figure 197 (left) shows a typical RF type EHT supply described in this magazine in January, 1957. The 6BW6 is at the right, the special coil in the centre and the rectifier on the panel at left. The circuit appears in figure 198 below.*




### RF OSCILLATOR

In this type of supply, a small power valve, usually an output pentode or beam tetrode, is made to function as an RF oscillator, operating from the normal HT line. Operating frequencies vary with individual design but usually lie in the region 50 to 300 Kc.

A winding having a very large number of turns is located within the field of the coils serving the basic oscillator, and across this tertiary winding a high RF voltage appears. This is rectified and filtered to produce voltages which can be as high as 15 KV and at currents up to about 1 milliamp.

(Still higher figures are obtainable from RF supplies using higher-powered or push-pull oscillators.)

Because of the very much higher ripple frequency, filtering of an RF supply can be accomplished with very much lower values of capacitance. This represents a saving in bulk and cost and also a reduction in the shock hazard already mentioned.

In addition, a failure in the main HT supply, affecting the deflection circuits, will also interrupt the EHT supply so that, in this respect, RF supplies offer partial protection for the picture tube screen.

Figures 197 and 198 show details of a 2 to 4KV RF type EHT supply, described in this magazine in January, 1957. It uses a 6BW6 beam tetrode in a push-tuned oscillator circuit.

The high voltage tertiary is wound

three pies in the centre of the coil former and between the grid and plate windings.

The accompanying article points out hat the tertiary winding has a pro-nounced self-resonance and maximum oscillator activity, with highest rectified output, occurs when the oscillator plate vinding is tuned close to the natural esonance of the tertiary. This affords a eady means of achieving the required rder of EHT voltage at the anticipated oad current.

The circuit as shown is arranged to eliver output negative with respect to hassis. By reversing the rectifier and perating its filament from a suitably nsulated winding, positive output can e obtained.

In actual fact, the rectifier specified as a low wattage filament (6.3V at 0mA) and some RF power supplies rovide for operating the filament of ch a rectifier from a few turns of avy wire wound around the coil rmer.

## HIELDING

RF power supplies normally require ielding where there is any risk of the F energy penetrating signal circuits and, r the same reason, leads to them norm-y have to be filtered and bypassed. e shape and construction of the unit tured in figure 198 lends itself to easy elding.

As indicated earlier, both mains-de-ed and RF type EHT supplies have n displaced, in modern television re-vers, by the so-called "flyback" sup-, operating in conjunction with the izontal output circuit.

Their design has been refined to the nt where the EHT circuitry represents y a small addition to the basic de-tion system and the economy factor herefore very strong.

igure 199 is a reprint of the earlier re 194 and includes a typical EHT oly. Its operation should be relative-asy to follow from the diagram and n the explanation given in the pre-ng instalment.

y way of revision, it will be recalled the positive-going line sawtooth e causes a rise in the plate current he horizontal output valve. This g current builds a magnetic field nd the winding and core of the out-transformer and simultaneously es the scanning beam from near-e of the screen to the right.

## LLAPSING FIELD

e negative-going stroke of the saw-cuts off the plate current and the etic field, which has been built up, oses and, passing through zero, s a new reverse field, in oscillatory on.

so doing, it generates a reverse across the transformer winding eturns the scanning beam from ex-right to extreme left, thereby ting the return trace.

en this new reverse field begins to se, in its turn, the damper diode oost capacitors take effect, causing agnetic energy to dissipate slowly he scanning beam to move from e left toward centre at a rate priate to the forward scan.

the beam approaches centre, the ntal amplifier takes over, swings am smoothly to the extreme right, uts off, to collapse the field and

# A TYPICAL LINE OUTPUT STAGE

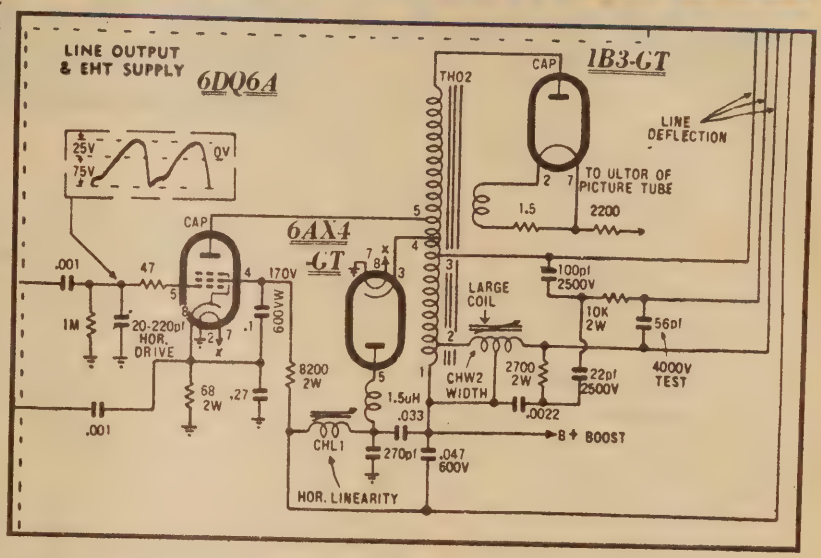



***Figure 199: Identical with figure 194, this shows a typical horizontal output stage, the operation of which was discussed in the last instalment. The EHT supply involves the 1B3-GT and the components connected thereto.***

produce the return trace once again, as already described.

As far as the EHT supply is concerned, the vital factor is the voltage developed across the output transformer primary during the flyback pulse.

On the forward trace, as we have seen, increasing plate current to the horizontal output valve causes a voltage drop across the winding impedance, thereby depressing the instantaneous plate voltage.

## POLARITY

Therefore, during the forward trace, the instantaneous voltage along the transformer winding is negative-going with respect to the HT supply point.

**During the retrace period, with the collapse of the forward deflection field, the EMF across the transformer winding is reversed, so that a positive-going pulse is now evident, with respect to the supply end.**

Because of the rate at which the field collapses and the fact that it is virtually a resonant phenomenon, the positive-going pulse achieves a very high peak value, amounting perhaps to some 5 or 6KV at the plate of the horizontal output valve. (This is one reason for the high insulation qualities built into horizontal output valves.)

Normal practice is to extend the winding beyond the point of connection for the valve plate, so that a still higher peak potential is built up, auto-transformer fashion. There is no difficulty in producing peak potentials of from 10 to 20KV, in this manner, during the flyback period.

The potential is applied to the plate of a special high voltage rectifier, constructed usually with the plate connection at the top of the bulb, filament connection to the base pins and with wide interelectrode spacing. This produces a high internal impedance but it is of no special consequence when the current drain involved is only in the order of micro-amps.

The rectifier conducts during each brief interval when the plate is positive with respect to filament. A series of positive pulses are therefore directd to the final anode of the picture tube, being changed to sufficiently pure DC by normal capacitor storage action.

But more of this in a moment.

Since the filament of the rectifier is the take-off point for the rectified EHT, at from 10 to 20KV, the provision of a suitable filament voltage could present a very real problem. There would be some difficulty, for example, in providing an appropriately insulated winding on the main power transformer. A series heater string, as in "transformerless" receivers, would present even greater difficulty.

Normal procedure, in modern receivers, is to use an EHT rectifier with a very low wattage filament, rather like a "battery" valve, and to energise it from a one or two-turn loop of heavily insulated wire around the core of the horizontal output transformer.

## EXTRA LOAD

While a very convenient system, operation of the rectifier filament imposes additional loading on the horizontal output valve and this has to be taken into account during the initial design of the deflection system. In the normal way, the designer would assume a certain type of rectifier and the filament winding would be proportioned to give the right order of output voltage.

Since the filament supply loop must consist of whole numbers of turns, it may not be possible to match the exact voltage requirements of the rectifier. In this case the number of turns is selected to give slightly higher than the requisite voltage and a dropping resistor inserted to absorb the difference. This is the reason for the 1.5 ohm resistor in figure 199.

The 2,200-ohm resistor in series with the EHT output is included mainly as a high frequency filter component but it

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does contribute something to the "DC" filtering, in conjunction with the EHT storage capacitor.

Here another economy is normally effected in modern television receiver design. No separate physical capacitor may be found, but it is provided instead by the capacitance between conductive coatings on the inside and outside of the glass envelope of the picture tube.

The inside coating is connected to the EHT circuit, while the outside coating is normally grounded to the chassis by a contact wire or spring.

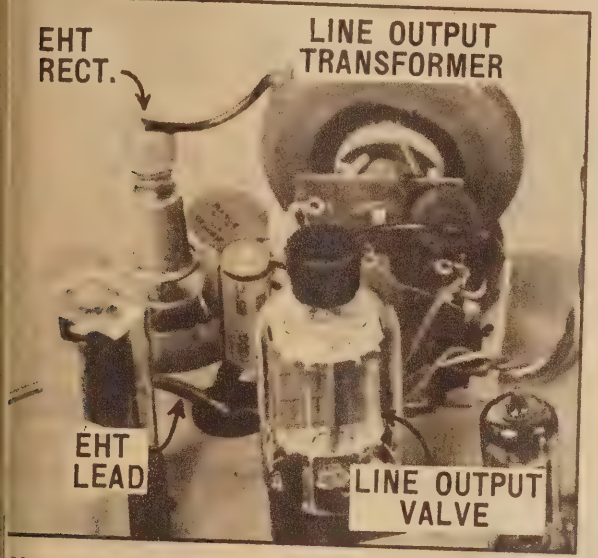
The inter-coating capacitance is usually around 500pF and, at a ripple frequency of 15,625 and at the very low current drain, this will normally give sufficient smoothing.

tion of the air molecules adjacent to a high-voltage point. It is accompanied by a "sizzling" sound, causes a blue glow visible in subdued light and often leads to breakdown of adjacent insulation.

Arcing produces a characteristic sharp "crack" and is usually associated with deterioration of the insulation path.

The active lead to the plate of the EHT rectifier is heavily insulated, with insulation emerging from within the coil coating and running right inside a shrouded clip fitting over the plate cap of the rectifier.

Care should be exercised in handling the components and wiring to avoid cracking the insulation and possibly promoting a corona discharge from the conductor thus bared.




☆

*Fig. 200*
*A typical line output and EHT system. (1959 TV Receiver). Note the construction of the transformer and the use of top cap plate connections on both valves, all aimed at minimising voltage breakdown.*

☆

Very little actual energy is stored by ch a capacitance and a shock from the HT circuit is something like that from motor-car ignition system — unpleast but not dangerous.

What danger there is arises largely om the physical reaction of receiving shock. It may cause one to strike picture tube, or drop it, or drop whole receiver, with disastrous rets.

## ARE NEEDED

It is especially important to note that inter-coating capacitance may store ergy for many hours on end and it is dom discharged by merely the once rting of the final anode cap to the er coating.

**Because of this, great care must be ken in handling tubes, in case one's gers should brush the anode conction and the shock reaction cause e to release the tube.**

As might be expected, the presence of h high voltages in a television reer necessitates some care to pro- e and maintain sufficient insulation obviate the risk of breakdown and ure failure.

he extended winding on the horizon- output transformer is normally of ll width but large diameter, having y layers but with only a limited vol- between successive layers. The le outer section is coated with a high ing point wax or similar insulating ing to discourage corona discharge outright arcing between the outer s and any adjacent metalwork.

orona discharge is caused by ionisa-

It is common practice to use a shrouded socket for the base of the EHT rectifier, with good quality insulation enclosing the area immediately adjacent to the base pins. The series dropping resistor and filter resistors, where included, can well be mounted right inside this shroud, so that only leads with unbroken insulation emerge from it to pass anywhere near other components or chassiswork.

A specially insulated lead is necessary from the EHT rectifier filament to the high voltage conection on the bulb of the picture tube, this connection being shrouded in turn by a hood, shaped rather like a suction cup. Once again, care should be taken to see that the insulation is preserved continuously.

## INSULATION DEFECTS

The point about all this is that voltage of the order of 15 KV will not puncture quite modest thicknesses of good quality insulation but it will arc over very considerable distances where a break or a hole in the insulation leaves an air path to chassis-work, etc.

A rough and ready test for the EHT in an ordinary TV set is its ability to jump a gap of 3/8-inch or so to chassis.

After a period in service, moisture, grease, and dust deposits can provide breakdown paths for the high voltage and cause deterioration or loss of picture In particular, the surface of the EHT rectifier may need occasional cleaning, as also the surface of the picture tube around the final anode connection.

A light film of silicone grease can help inhibit moisture effects.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| 954 .... | 1/6 | 6X5 .. | 9/6 |
| 6L7 ... | 12/6 | EF50 .. | 1/6 |
| 1P5 .. | 1/6 | 7A8 .. | 5/ |
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| 807 ... | 11/6 | 6SH7 .. | 2/3 |

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2,000 ohms/V AC/DC.
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# FLASHERS

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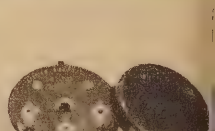
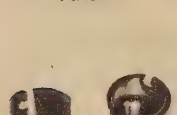
NEW TYPE D LAMPHOLDER FLASHER

TYPE B

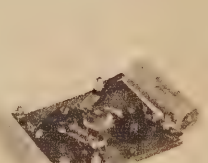
TYPE C



TYPE SF



TYPE 1
TEMPORARY USE ONLY



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385 BRIDGE ROAD, RICHMOND, VIC.
JB 1416.

Normal practice in television receivers is to enclose the horizontal output transformer and EHT rectifier in a perforated metal box above the chassis, large enough to ensure preferably ¾-inch clearance between the metalwork and ready-insulated circuitry carrying EHT.

In many cases the horizontal output valve and some of its associated components are also enclosed in the shield box.

Purpose of the shielding is partly to afford physical protection and partly to provide shielding against high frequency components which could penetrate signal circuits and cause interference with the picture.

And, here, one final word:

The whole character of a flyback type EHT supply conspires to give it a high internal impedance so that it exhibits poor voltage regulation. Thus, as the brightness control of a receiver is advanced, and the beam current rises, the anode potential falls. This affects the deflection sensitivity though it reacts also on the horizontal amplifier.

In the sum total, however, some interaction is normal between picture brightness and picture size because of these effects.

## LAST WORD IN CLEANLINESS

AIR in a part of the New York factory of the General Electric Company (U.S.A.) was found to be cleaner than air in the Arctic.

This discovery was made by the company's general engineering laboratory, which has been conducting regular tests on the air in the "Snow White" room where minute parts of television camera pick-up tubes (image orthicons) are assembled.

Detecting, counting and controlling invisible airborne particles (so tiny that 1,000 of them laid end-to-end would equal only the thickness of a human hair) has become a necessary adjunct to camera tube manufacture.

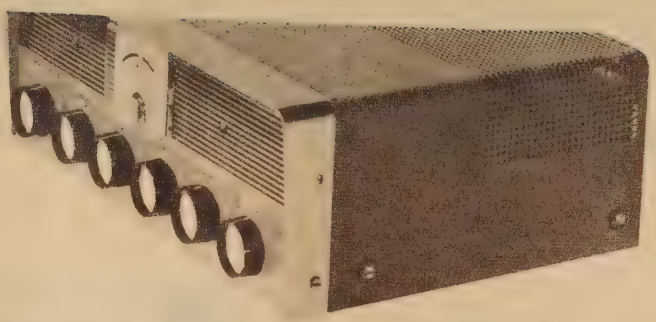
The company's physicists say the air in the ultra-clean factory room contains about 3,000 of these invisible particles per cubic centimetre, while the air in an air-conditioned office was 35,000 particles per cubic centimetre, and the air in a heavy industrial city is loaded with 170,000 particles per cubic centimetre.

Control of air contamination in manufacturing and assembly areas is imperative.

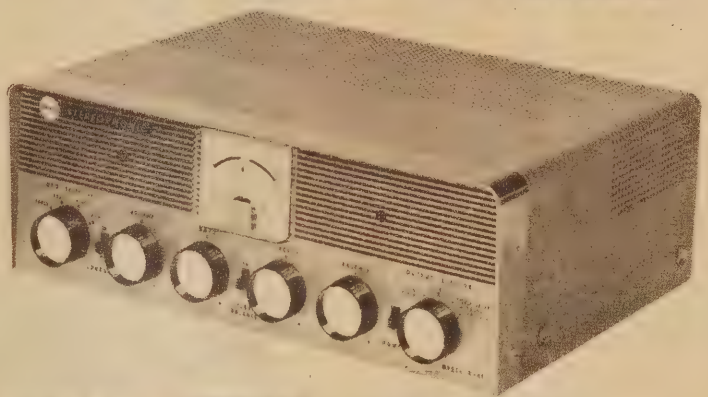
A visible piece of dust on the target of an image orthicon, being used in a television would appear as large as a boulder on the home viewer's screen.

Tests of the air cleanliness in the tube factory are made with a "condensation nuclei detector" developed by the General Engineering Laboratory of General Electric. This device can measure particles ranging in size from one micron (0.000000039 of an inch) to one micron (0.0000039 of an inch).

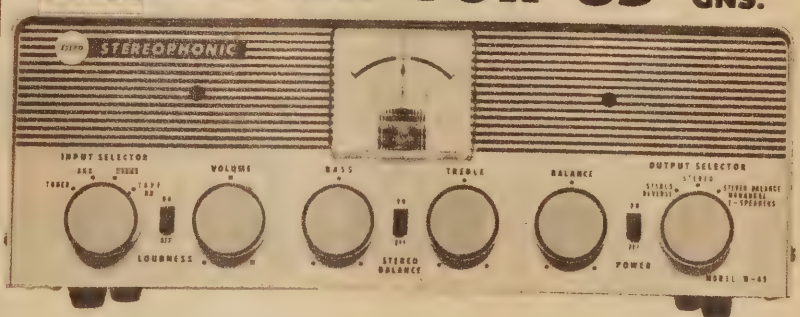
The air is kept clean in the "Snow White" room by a combination of methods and devices which includes air-conditioning, air-conditioning, frequent vacuum cleaning, air locks for entry and exit, use of lint-free clothing, hats and rubber finger cots.

A 36-WATT STEREO



AMPLIFIER FOR 85 GNS.




The Trio Model W-45 Stereophonic Amplifier has been designed and built for trouble-free reproduction of the highest possible standards. The twin 18-watt stereo sections will handle the loudest and most complex musical passages with effortless ease, while a switched Loudness Control (separate from Volume Control) permits the full dynamic range to be enjoyed even when listening at very low levels. The Trio will operate direct from the Decca and other high-quality pickups. Perfect balance is assured with the exclusive built-in Balance Meter. Trio also functions as a true single channel, single speaker, 36-watt amplifier for high-quality monophonic applications.

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Mastersound, 400 Kent Street, Sydney.
Please forward particulars on Trio Stereo Amplifier.
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ADDRESS.....
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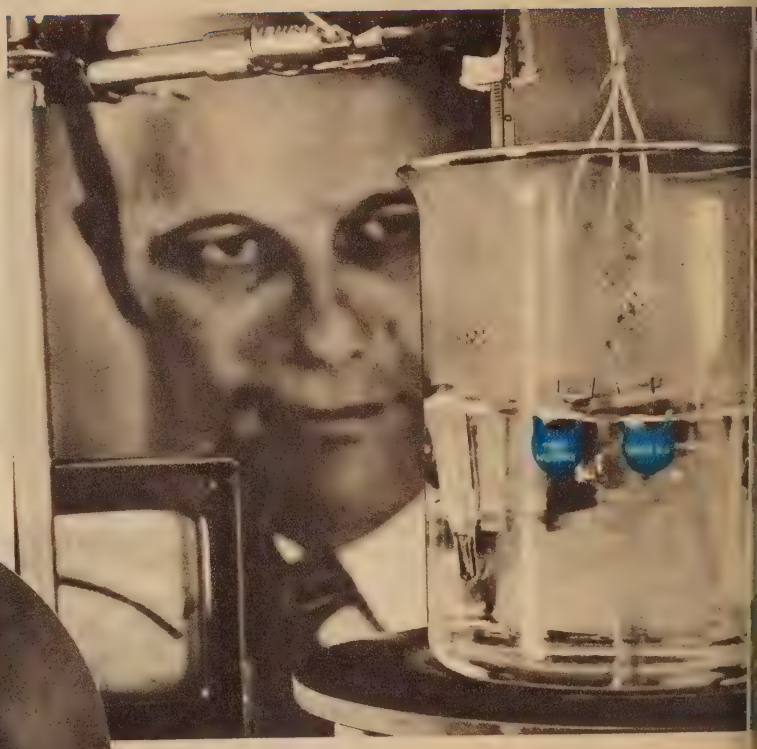
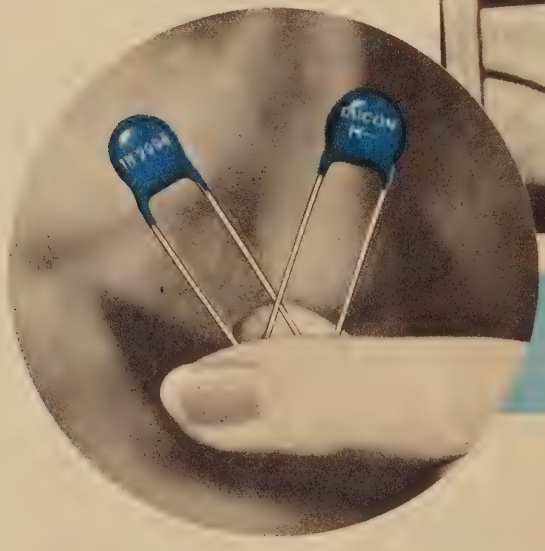
# High Quality and Dependability with

This boiling water test proves the Ducon "T" Silicon Rectifier has extremely high resistance to humidity.

The test is applied for eight hours with power applied to the rectifier, and for 16 hours soaking cycle at room temperature without power.

These unique Mallo-Seal* coated rectifiers have proved impervious to moisture with no failures after 500 hours — four times the humidity cycling required by MIL 202A, method 106.






**Note the small, completely insulated body. Ideal mounting directly between adjacent terminal bo tags and to printed circuits.**

* *A development of Radio Material Corporation, a division of P. R. Mallory & Co. Inc., U.S.A.*

***Full information and application data available from SEMICONDUCTOR DIVISION***

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# DUCON "T" series Silicon Rectifiers

The Ducon "T" series Silicon Rectifier, an encapsulated diffused junction type represents a major break-through in semiconductor design. Among the outstanding features of type "T" are:

**UALITY CONTROL—**
ingent quality control functions at all assembly levels. eal semiconductor production conditions ensure a ntinuously reproducible top quality product.

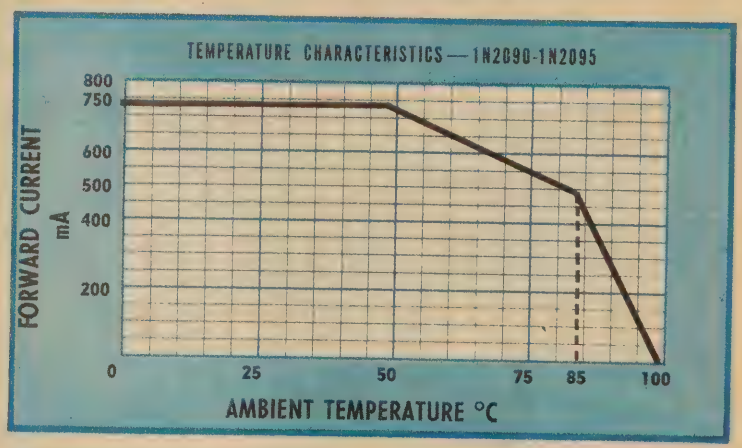
**0% AUTOMATIC INSPECTION—**
tomatic equipment checks every rectifier at an elevated perature for peak inverse voltage, reverse leakage rent, and forward voltage drop.

**W FORWARD VOLTAGE DROP—**
s than 0.5 volt at 85°C ambient temperature and 500 forward current.

**LIABILITY—**
er 2,000 hours life test at 85°C ambient temperature. n maximum rated load switched 1.5 million times. trical characteristics remain practically unchanged nout a single failure.

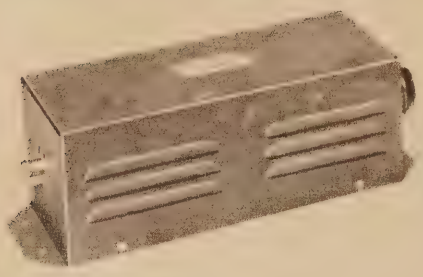
**HIGH LOAD CURRENT v. TEMPERATURE RATING—**
750 mA at 50°C ambient
500 mA at 85°C ambient

**LOW REVERSE LEAKAGE CURRENT—**
Less than 250 μA at 85°C ambient temperature, at rated PIV.

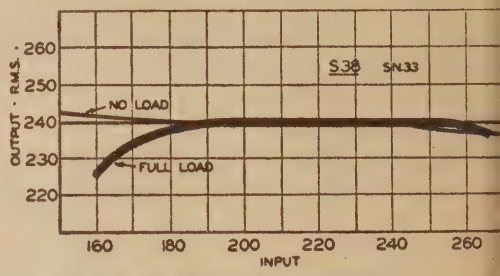



| RATINGS and SPECIFICATIONS 60 c/s RESISTIVE AND/OR INDUCTIVE LOADING | 1N2090 | 1N2091 | 1N2092 | 1N2093 | 1N2094 | 1N2095 |
|---|---|---|---|---|---|---|
| Maximum Allowable P.I.V. | 50 | 100 | 200 | 300 | 400 | 500 V |
| Maximum Allowable RMS voltage | 35 | 70 | 140 | 210 | 280 | 350 V |
| Maximum Allowable Continuous Reverse DC voltage | 50 | 100 | 200 | 300 | 400 | 500 V |
| Minimum Value of Limiting Resistor | 5 | 5 | 5 | 5 | 5 | 10 Ω |
| Maximum Allowable One-cycle Surge Current | 15 A | | | | | |
| Maximum Peak Recurrent Forward Current | 5 A | | | | | |
| Maximum Surge Current - 4 mS | 35 A | | | | | |
| Maximum Full-load Forward Drop - Full cycle Avg. at 85°C | 0.5 V | | | | | |
| Maximum Leakage Current - Full cycle Avg. at 85°C | 0.25 mA | | | | | |
| Maximum Allowable DC Output Current - at 50°C ambient<br>at 85°C ambient | 750 mA<br>500 mA | | | | | |
| Ambient Operating Temperature | - 55°C to + 100°C | | | | | |
| Storage Temperature | - 55°C to + 100°C | | | | | |

# VOLTAGE REGULATION!



Use the TRIMAX 50va 50 cycle voltage regulator and be sure that line voltage variations no longer upset your instruments.




Available with flexible lead entry and 3-pin socket S38 or with conduit entry and outlet S40.

## TRIMAX for TRANSFORMERS

### AND ASSOCIATED EQUIPMENT

## TRIMAX TRANSFORMERS PTY. LTD.

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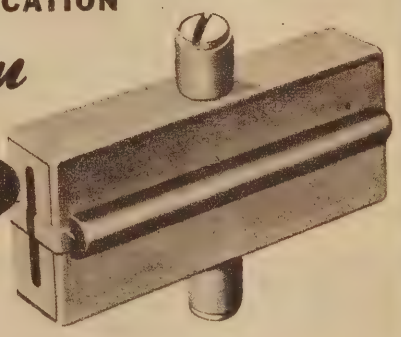
## ELIMINATE EXTRA TV ANTENNAS

### AND AMPLIFICATION

with the *Cunningham*

**ML-300**



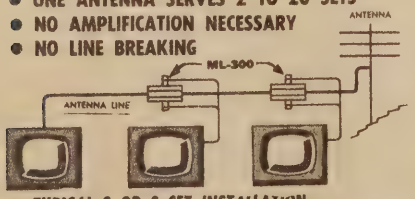
ELECTRO MAGNETIC

### TV SET COUPLER

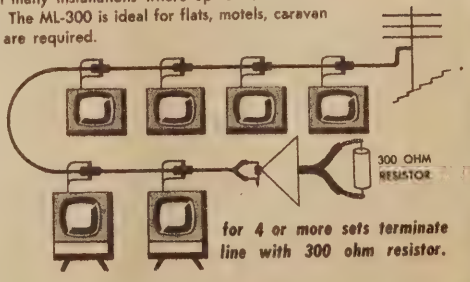
FOR 300 OHM TWIN LEAD

The high electrical efficiency of the ML-300 is proven in many installations where up to 20 receivers are operated from one antenna — without amplification. The ML-300 is ideal for flats, motels, caravan parks or in any installation where multiple T.V. outlets are required.

- ONE ANTENNA SERVES 2 TO 20 SETS
- NO AMPLIFICATION NECESSARY
- NO LINE BREAKING




TYPICAL 2 OR 3 SET INSTALLATION.




for 4 or more sets terminate line with 300 ohm resistor.

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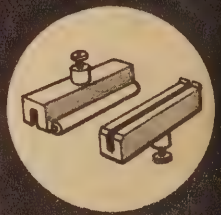
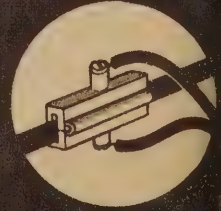
EASY TO INSTALL
THE ML 300
SLIDES APART



PLACE TWO HALVES ON LINE AND SLIDE TOGETHER

NO CUTTING — SPLICING
SOLDERING — NO SHOCK HAZARD



CONNECT TO SET

# S RECORDING LEVEL TOO HIGH?

**I had something to say recently about the current tendency to record discs—particularly mono "pop" 45's—at what seems an unduly high level. I am now in a position to make some further observations on the subject.**

*by Neville Williams*

S stated earlier, the tendency to push levels upward appears to be prompmainly by each organisation's desire ensure that their own discs always nd at least as loud as the opposii's under "automatic play" conditions. uch conditions include "juke boxes," lequately monitored radio stations domestic automatic record players, in of which record follows record with- any attempt at individual level adment.

s far as "pop" discs are concerned, e three add up to a substantial proion of the total market.

ince publication of my earlier reks, it has become apparent that rs in the trade have a much more nt interest in the matter than I. They worried by the rising tide of dision which follows in the wake of er recording levels.

ho wouldn't be, when faced by omers who complain that a stylus, idge, pickup or complete radiogram n't play properly this new record I've bought."

or is there very much satisfaction ing able to show that the same item play certain other records. It cer- doesn't satisfy the customer.

## NTS TO CONSIDER

owever, before proceeding from this to a general condemnation of recompanies, it is necessary to concertain possibilities, as already ioned.

Is this distortion basically "inherin the troublesome discs by virtue possibly steep wavefronts?

Is it that the wavefronts are "prac- but beyond the capacity of ordinickups to track?

Is there a tracking problem for discs, at least, due to the increase of 0.7 mil. "universal" styli?

Is overload occurring in the preary stages of some amplifiers?

sonally, I am prepared to attach importance to each of the proposibut certain observations, made dure last month, focus attention par-ly on number (2)—the ability (or vise) of ordinary pickups to track heavily modulated grooves.

me explain:

before ending up in hospital, some r five months ago, I was handed for review—a 12-inch stereo disc he Desert Song," HMV OCSD

he time I was experimenting with crystal pickups and Control Units . and the disc found its way on turntable. The first few grooves d very good indeed, but then he "fortissimos" and, with them, istortion.

I tried the disc with three separate crystal cartridges and one magnetic, all with much the same result, and finally put it aside for future reference with a note in the jacket "gross distortion on loud passages."

As it turned out, "future reference" was delayed a lot longer than I foresaw. In the meantime, a couple of new magnetic cartridges had turned up for review—to be precise, a "Stereodyne" and an "Empire 88."

## A SECOND TRY

While testing these, I happened to remember "The Desert Song." You've probably guessed the answer: Both cartridges played straight through the disc, with only a vague suggestion of discomfort on peaks. There was certainly no "gross distortion" of the type I had noted earlier.

At this stage an engineer friend turned up with three or four mono discs, which had been selected as "virtually unplayable" on current commercial radiograms. I can't debate the exact implications of his definition, but their failings varied from gross distortion to tossing the stylus right out of the groove.

Again, both magnetic heads (and both using fine styli) played straight through the discs without the slightest bother. To be sure, the output level was notably high, but the reproduced quality was perfectly clean.

I do not intend by this to suggest that there is anything magical about the Stereodyne or Empire 88 cartridges, although both are held in good repute overseas. They just happened to be the ones I was working with. Other magnetic cartridges of equal merit would doubtless have behaved in precisely the same fashion.

But the important point is that several records, which had been classified as grossly distorted or unplayable, proved to be perfectly playable on more advanced gear.

## DYNAMIC STYLUS MASS

Nor, do I think, is the difference very hard to find. The Empire 88, for example, is quoted as having a dynamic stylus mass of less than 0.7 milligram. Many commercial "turnover" pickups are credited with a dynamic stylus mass of several times this figure.

It simply means that the groove cannot accelerate the stylus fast enough or far enough to cope with steep, complex wavefronts. Skating, riding and

## NEW AMERICAN STEREO PICKUP

*THE latest offering to the audiophile from Pickering is this combination of their Model 380A Collector's Series cartridge with their Unipoise arm. Extremely light in weight and originally designed for measurement and calibration work, the arm is poised on a single pivot. Specifications are response plus and minus 2db, 20-15,000 cps; output 15 millivolts per channel; separation 35db; tracking force 2-5 grams; weight 12 grams. (Details from Ad. Auriema, Inc., 85 Broad Street, New York 4, N.Y.)*

# TYPE 16 XA

## CRYSTAL MICROPHONE

*complete with*
*Base and Stand Clip*

AUSTRALIAN MANUFACTURE
HAND–DESK–STAND
— USE —

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*Metal case finished Burgundy and Gold*

Stand clip attached to base by captive screw and easily removed for stand operation in conjunction with Type 208C Adaptor.

Frequency — 70-6500 cps.

Output level — 42db (0db-1volt/dyne/cm2)
Impedance — Grid (1 to 5 megohms.)

Use adaptor 208C with stand clip

*Manufactured by*

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## ACOS REPLACEMENT CRYSTAL CARTRIDGES

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PRICE:
Twin Sapphire Styli, £2/18/6.
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**GP67-2G.**
High gain turnover crystal Cartridge, suitable for reproducing standard and micro-groove recordings with low gain amplifier.
PRICE: Twin Sapphire Styli, £2/3/-.
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**GP61**
Turnover ceramic Cartridge. Unaffected by heat or humidity. Specially designed for tropical areas.
PRICE:
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**HGP39**
Crystal Cartridg
Available for standa
or L.P. recordings f
use with HGP20 ar
HGP40 Pick-up Arm
PRICE:
Single Sapphir
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## ACOS STEREOPHONIC CARTRIDGES

AUSTRALIAN AGENTS.

**GP73 Series**
Turnover stereophonic Cartridge, plays all types of recordings. GP73-2 Medium output. GP73-5 High output. Available with standard ½" mounting bracket (type A), or special mounting bracket for end mounting (type B).
PRICE: Twin Sapphire styli, £3/6/-. Sapphire/diamond stylus, £7/13/6.

**GP71 Series**
Cartridge plays stereo and L.P. recordings, non-turnover type.
PRICES: GP71 with sapphire stylus, £3/6/-.
GP71 with diamond Styli, £5/16/6.

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ticity effects all supervene, with ndant distortion and an occasional right out of the groove.

rankly, I doubt that it is purely a ter of amplitude but rather a com- ition of amplitude with a complex e pattern. In the case of "The Desert g" mentioned earlier, there is high litude, a highly complex sound pat-, the stereo track and a very heavy content for good measure.

dd these together and it takes a y good pickup to track the result, out misbehaving somewhere.

ut where does this get us? I doubt record manufacturers can realisti- take refuge in the thought that "difficult" ones are always playable, good enough equipment.

fter all, why stop with the cartridges ve mentioned? It must be possible o beyond their capacity again, to more exacting limits.

e simple fact of the matter is that eneral public still demands pickups "turnover" cartridges and prac- y every radiogram on sale in Aus- is so equipped. This includes the expensive ones and models put out he same organisations which sell ds.

e manufacturers of mass-produced ps have come a long way in recent but, while they have to stick to igh-output low-cost "turnover" for- they are up against very definite of weight, compliance and dynamic

en so, the best mass-produced pick- an sound very impressive — with ds which have been engineered with present-day limits in mind. The le arises when those limits are ressed for such a dubious reason.

s must not be construed as a plea owered standards. The recorded ial should contain adequate dyna- range and be far enough above ng noise for this not to be a m, but these things can be ed without going to limits which mbarrass the general record-buying

## AT TO USE?

ere the record reviewer stands in nship to the problem is open to debate.

uld he use only the highest grade nent and risk overlooking tracking ms, which could worry the ty of his readers?

uld he "do as the Romans do" se deliberately "average" equip-

uld he have both and play every right through twice? If so, when e sleep and where?

for good measure, another matter ently worrying equipment manu- s—the urge to crowd more on to a 7-inch disc than the ion. Among other things, it s recording closer to the label.

big trouble is that the run-off s so compressed that it will not operate all trip and changer sms.

know, if I owned a changer, prepared to put up with a few less of music, provided I didn't hop up every now and again the thing work.

# VOICE FROM PAST—PLUS STEREO

**How is it that an artist who died seven years ago can be featured in a new stereo release? Some may well ask this question when they note a re-issue of Bach-Handel music recorded by the late Kathleen Ferrier.**

*THE new issue is not a tribute to someone's uncanny foresight. Rather is it a tribute to the skill of Arthur Haddy, Decca's chief recording engineer, and James Walker, a Decca technician credited by Ernest Ansermet as having "the best pair of ears in Europe."*

*Kathleen Ferrier never had the opportunity to record for stereo, though many wished she had. Walker decided that something could be done about it.*

*On a certain day, quite recently, the London Philharmonic orchestra was assembled in the Kingsway Hall, together with conductor, Sir Adrian Boult.*

*Eight years before, in April, 1952, the same orchestra had been similarly assembled to record with Kathleen Ferrier — using conventional mono equipment. That recording session had been notably successful.*

*In the eight years which had intervened the personnel of the orchestra had undergone much change and there were many present on the second occasion, who had certainly not been present on the first. But everybody, from the conductor down, had listened over and over again to the original recording.*

*They knew it well. They had noted the characteristic idiosyncrasies of the earlier perfomrance.*

*When Sir Adrian Boult took the stand, he had, at his elbow, a small loudspeaker running at a level just high enough for him to match the beat. The really difficult part was to match the complex weavings of the harpsichord and adobe d'amore to the original counterparts.*

*In the recording booth, the signal from the original tape was being filtered of all bass and treble not strictly necessary to preserve the artist's voice. The residue was being mixed with the stereo signals from the hall, in a way which would put Kathleen Ferrier centre stage, with the orchestra spreading around and behind her.*

*A critic, hearing the result, has said, "Here was Ferrier's matchless voice singing Bach and Handel in three dimensions, fuller and more detached than I had ever heard it before, flanked and backed by the most stereophonic orchestra imaginable."*

*The new album comprises, from Bach: "Grief For Sin," "All Is Fulfilled," "Qui Sedes" and "Agnus Dei;" from Handel, "Return, Return," "Father Of Heaven" "O Thou That Tellest" and "He Was Despised."*

*COMMENT:—The technique of re-recording voices from the past with new accompaniments is not in itself unique. But extension of the technique to stereo may well confer a notable advantage in that spatial effects can help separate the original voice from its new, full-frequency accompaniment, giving better definition to both. Though far more difficult and more costly to prepare, stereo reissues of this type may have much greater appeal than the present crop of mono re-dubs from old discs. Whether the noise is left in or filtered out, the result is generally so far short of modern recording standards, that it is hard to generate any great enthusiasm for them. (Editor R., TV and H.)*

# A REVIEW OF SACRED RECORDS

**"THE CHURCH SINGS." Hymns and Anthems by the Westminster Choir of the First Presbyterian Church, San Diego, California. Directed by Harold G. Lutz. Mono, Coral. CL-7646.**

No qualification is needed in summing up this disc. The choir belongs to the second largest Presbyterian church in the U.S.A. and, as might be expected, it is a very good choir indeed. The direction and response under Harold G. Lutz is of a high order, as also is the organ accompaniment by Virginia Cox.

Hymns and anthems included are as follows: "Glorious is Thy Name (Mozart); "Soul of Christ" (Lapo); "Holy, Holy, Holy," (Dykes); "I Will Lift Up Mine Eyes" (Sowerby); "Of The Light Of Dawn" (MacKinnon); "If Thou But Suffer" (Newmark); "For Thine Is The Kingdom" (Thimen); "Open Wide" (Lutz); "Wherewithal Shall I Come Before The Lord" (Bush); "Hallelujah, Amen" (Handel); "I Sing The Mighty Power of God" (Ellacombe); "May The Words Of My Mouth (Hebrew Melody); "Sheep And Lambs" (Homer); "If God Be For Us (Lutz); "Spirit Divine Attend Our Prayers" (Curger).

Technically, the disc is excellent and a good investment to anyone interested in choral music of this type.

★ ★ ★

**"TENDERLY HE WATCHES." Vocal stylings by Jerry Barnes. Mono, Gospel Film Ministry. GFM 36-W3041-LP.**

I recall having made favourable comment on an earlier disc by Jerry Barnes, who has a pleasant, easy voice, which reminds one strongly of Bing Crosby, at least in the lower register.

However, a tendency to falter on sustained tones, which was noted in the earlier disc, seems more prominent on this one and mars the end result somewhat.

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Against this, he is backed throughout by a skilfully woven Wurlitzer organ accompaniment, for which, rather strangely, no credit is given on the jacket.

The theme of the hymns, which will be unfamiliar to many is—and I quote—"the awareness of the watchful care of the Heavenly Father;" the title "Tenderly He Watches," is the title of one particular hymn.

The disc is technically good, with adequate response, well monitored and with no background noise of any consequence.

★ ★ ★

**"MEDITATION AT DAWN." Vol. 2, Lew Charles (organ) and Charles Morris (piano) produced by Paul Mickelson. Mono, Gospel Film Ministry. GFM26-W3069LP.**

Though both artists are accomplished musicians in their own right, there is little or no attempt here at outright "Keyboard gymnastics." In a couple of numbers rhythm reigns briefly but, for the most part, the music takes the form of a straight organ solo with piano emphasising the melodic line.

The organ is "electric," as near as I can judge a modern Hammond, but played smoothly and with plenty of full-bodied bass.

The hymns, some old, some not so old, could be related under theme "Hymns for the start of the day," which isn't quite as poetic as the album's official title.

The quality of reproduction throughout is clean, noise level generally low. On all, rather pleasant listening.

★ ★ ★

**"THE LORD'S MY SHEPHERD," Bill Pearce with the Concert of London, orchestrated by Paul Mickelson. Mono, Gospel Film Ministry GFM23—W3063—LP.**

This is the first record I have had of Bill Pearce, listed as staff vocalist for a Gospel Radio Station and also a reviewer of sacred records. He has a smooth bass-baritone voice, comparing well with some of the better known names in the field.

Orchestral arrangements are by Paul Mickelson, who seems to be doing a lot of this for "Word" recordings in the U.S., from which the local "GFM" label is derived.

Orchestra and vocalist team well in the presentation of twelve hymns of established though not traditional popularity. It would be a very acceptable addition to anyone's library of "gospel recordings."

Technically, the quality is quite up to standard.

★ ★ ★

**"CHILDREN'S HYMNS" sung by Kathleen McCormack. Mono, 7-inch extended play 45, Columbia SEDO 70001.**

There are four hymns on this disc as follows: "Gentle Jesus," "I Think When I Read," "Lead Us Heavenly Father" and "Now The Day Is Over."

They are sung in a simple, straightforward style by Kathleen McCormack, Irish by birth but now resident in Australia. She has a pleasant contralto voice. The accompaniment, again in simple style, is by Richard Thew on an electronic organ.

An excellent present for a child.

★ ★ ★

**BENIAMINO GIGLI — Tenor, "Ave Maria" and "Agnus Dei." Mono, 7-inch 45 rpm, HMV 7PO 34.**

These two well known sacred numbers have presumably been transcribed from earlier recordings by the famous tenor. The sound of a filtered 78 rpm disc is unmistakable in "Agnus Dei" but "Ave Maria" (Bach-Gounod) carries little evidence of its origin.

If you like the contents, the record is well worth its modest price.

★ ★ ★

**RICHARD CROOKS — Tenor, "The Holy City" and "Star Of Bethlehem." Mono, 45 rpm; HMV 7PO 121.**

There should be a ready market for this presentation of Richard Crooks and two evergreen sacred songs.

Transcribed, probably, from earlier recordings, both sides play well, apart from a slight background crackle and equally slight distortion on peaks.

## HI-FI HEADPHONES FOR STEREO

*THE possibilities of listening to stereo per medium of headphones have often been discussed but ordinary types are not suitable, because of limited response and high distortion level.*

*A Milwaukee manufacturer, John C. Koss, has recently taken the opportunity to plug this gap by the release of the Koss stereophones, pictured here.*

*Koss claims that there is a marked upswing in "personalised" headphone listening and several manufacturers are now installing headphone jacks on the rear of their amplifiers.*

*He claims that use of headphones ensures good stereo listening irrespective of room acoustics or the seating arrangement. Compared with ordinary loudspeaker presentation, the stereo separation with phones is said to be "dramatic."*

## IN VARIED MOOD

**"GREAT SYMPHONIC WALTZES," Igor Markevitch conducting the Philharmonia Orchestra. Mono, World Record Club, TE226.**

As one might infer from the title, this is not a collection of traditional Viennese waltzes nor has it, in fact, anything in common with the ballroom.

In presenting these selections, Igor Markevitch sets out to paint a musical portrait of the waltz as a musical form and employed through the years to capture the widest range of human emotions. He claims no magical formula in making the selection; many other "portraits" could have been painted, of no less merit than this one.

As it is, Markevitch presents "Danse Macabre" (Saint-Saens) and "Valse Triste" (Sibelius), both well known and aptly described by their titles. These are followed by "German Dance, No. 3" (Mozart) and "Tanzwalzer" (Busoni).

On side 2 is "Mephisto Waltz" (Liszt), "Danse Of The Sylphs" (Berlioz), "Waltz From Suite No. 2" (Stravinsky) (these last two quite short items) and "Fete Polonaise" (Chabrier).

The playing throughout is concise, the recording quality good and the noise level low. This last is not only commendable but very necessary for the dynamic range is so wide that many softer and solo passages would otherwise be lost.

Apart from the normal appeal of the items, the disc should be a good "extension" for those whose tastes do not normally run to symphonic orchestration.

★ ★ ★

**"THE DESERT SONG," with Edmund Hockridge, June Bronhill, Julie Dawn, Leonard Weir, Inia Te Wiata, Bruce Forsyth, The Williams Singers and Michael Collins and his orchestra. Stereo, HMV OCSD 1272.**

The ever-popular melodies from "The Desert Song" are presented in dynamic fashion by the cast of singers, as above, and by Michael Collins. The diction is excellent throughout and effective use of stereo spreads the orchestra out behind the singers.

Musically, you should like it, but . . .

As mentioned in my preliminary notes, this seems to be a notably difficult record to play well. It is stereo, it is

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recorded at quite high level, it is a combination of full orchestra and boisterous singing, it has a heavy bass content.

Maybe I was unlucky but three crystal pickups and one of the older magnetics failed to do it justice, though a couple of later cartridges played it cleanly.

You can take this either way — a warning or a technical challenge.

★ ★ ★

**"PERFECT FOR DANCING," with Edmundo Ros and his Orchestra. Stereo, Decca SKLA 4029.**

This is one title with which I have no desire to quarrel. In strict tempo, Edmundo Ros presents a dozen selections, in waltz time, quick step, tango, samba, mambo, biaio and cha cha cha.

If you don't actually want to dance, the music makes for pleasant listening, tuneful, varied, but with an overall Latin-American flavour.

Or again, if you're looking for something of this type to show up your stereo equipment, you won't go far wrong with this disc. The quality of reproduction is particularly clean and effective use is made of the two channels both for spread and for separation.

★ ★ ★

**BILLY VAUGHN plays Stephen Foster. Mono, London HAA7575.**

The traditional melodies of Stephen Foster have seldom sounded brighter and more listenable than on this latest disc of Billy Vaughn and his orchestra. Voices, strings, woodwinds, harp and a restrained rhythm background produce a variety of sound and tempo that entertains the ear, without ever transgressing the spirit of the music.

The quality of recording is outstanding throughout. Whether you own a mono system or a stereo, you'll be happy with the sound that comes off this disc.

★ ★ ★

**"HAWAIIAN STRINGS," presented by Webley Edwards. Mono, Capitol, T1152.**

Recorded in Honolulu, this whole disc is in dreamy, leisurely mood, befitting the waving palms and rolling combers of the South Pacific.

A variety of guitars, with ukulele, mandolin, string bass and vibraphone are featured in the dozen "island" numbers. It's all very pleasant listening, if you're in the mood.

Hi-fi fans will probably notice a slight lack of sparkle at the top end, but there's plenty of bass to compensate and not a distorted note anywhere that I can recall.

★ ★ ★

**"ALWAYS," Roger Williams (piano), with orchestras directed by Frank Hunter and Pete King. Stereo, London SAHA 7512.**

Maybe it was the mood after a good meal, but I thoroughly enjoyed this best recording from Roger Williams. Under the subtitle "Melodies That Will Live Forever," the dozen selections are nicely graded from the simple melody of "Traumerei" to the complex rhythm of "Dark Eyes"; from "Moonlight Sonata" to a Chopin Polonaise, under the guise of "Till The End Of Time."

There are other numbers, of course, a dozen in all, but every one well-known and every one easy on the ear.

Technically, the disc is right up to standard, with the stereo broadening the presentation so unobtrusively that it might easily pass unnoticed.


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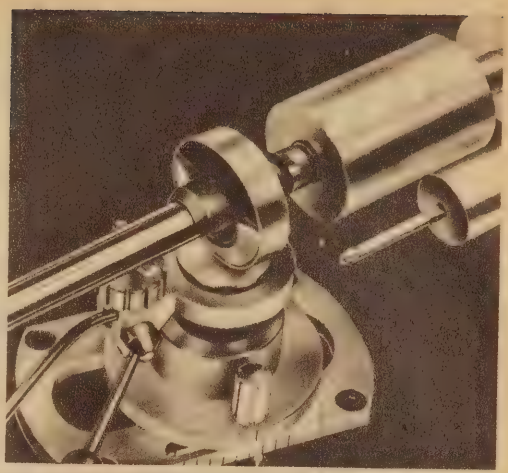

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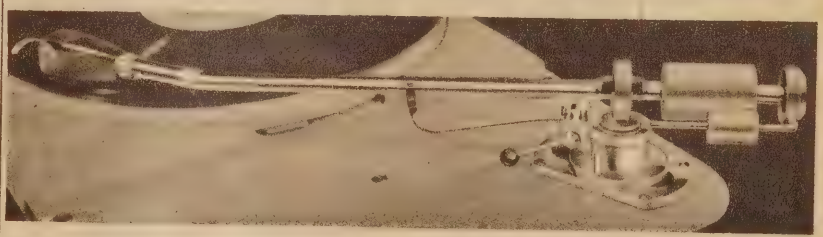

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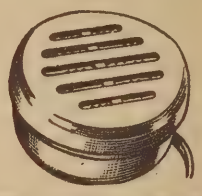

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# IN REVIEW—By JULIAN RUSSELL

## FINE FEAST FOR OPERA LOVERS

**Bizet—Carmen. Complete opera. Carmen (Victoria de los Angeles); Don Jose (Nicolai Gedda); Micaela (Janine Micheau); Escamillo (Ernest Blanc); Frasquita (Denise Monteil); Mercedes (Marcelle Croisier, Monique Linval); Dancaire (Jean-Christophe Benoit); Remendado (Michel Hamel); Morales (Bernard Plantey); Zuniga (Xavier Depraz). With the Chorus and Orchestra of the Radiodiffusion Francaise conducted by Sir Thomas Beecham. HMV Mono OALP—1762/4.**

Those who remember Beecham's superb La Boheme set of about three years ago will expect great things of his new Carmen. They will not be disappointed, since this performance is unlikely to be matched for many years to come.

It carries Beecham's imprint all over it—a careful re-examination of the score and discarding of bad habits that have grown to be a part of its structure since it was written, a firm yet never harsh direction of his soloists, and incomparable co-ordination of all concerned in the production.

Although Victoria de los Angeles is a Spanish soprano, hers is still a surprising performance. In the first place the part is often sung by a mezzo, and a fiery one at that. Indeed the role has been a plum one for mezzos for generations.

But though Madam de los Angeles has till now appeared in gentler roles she here delivers a part of enormous dramatic weight with surprising authority in all but one scene—the Card Trio. And even in that her only shortcoming is a lack of "darkness" in her low register.

Elsewhere she is Carmen to the life, passionate, wilful, mischievous and completely amoral.

She is partnered by a vivid Don Jose in Nicolai Gedda who also brings great vocal and dramatic resources into his interpretation of the unhappy lover.

Then there is Ernest Blanc, the excellent Valentino in HMV's recent Faust (Gounod) set, swaggering like a true bullfighter as Escamillo.

One of the small disappointments is Janine Micheau's Micaela, who, though intended by the composer to be a young, innocent country girl, is a thought too pallid to stand up to the others' magisterial performances. And Beecham, perhaps out of consideration for her vocal limitations, takes her second aria much slower than is usual.

The chief smugglers, both men and women, are all highly efficient and the famous quintet at the end of the Inn Scene goes with fine precision and expression.

The chorus and orchestra are constantly alert to Beecham's every exacting demand, and HMV have done all concerned proud in gving them fine, spacious, rich-toned reproduction that, though on mono, sounds grand on stereo equipment.

However, those with two-channel sets might find it prudent to wait until they hear the stereo version which is due for release in the near future.

Those who still have mono, however, can do no better than invest in this splendid set.

★ ★ ★

**Verdi—Aida. Complete opera. Aida (Renata Tebaldi); Amneris (Giulietta Simionato); Radames (Carlo Bergonzi); Amonasro (Cornel Macneil); Ramphis (Arnold van Mill); King (Fernando Corena). The Vienna Philharmonic Orchestra and the Singverein der Gesellschaft der Musikfreunde conducted by Herbert von Karajan. Decca mono LXT 5539-40-1.**

*". . . a grand recording, presided over resourcefully by Karajan."*

Although the sound on this is splendid, especially so if played on two-channel equipment, a stereo version is to be issued in Australia, and may even be on the market at the time this is read. I therefore again advise owners of stereo to curb their impatience until they hear the two-channel set. Should they sample the present set they may not find this easy to do.

It is a grand recording, presided over resourcefully by Karajan who, despite his Austrian origin seems to have an affinity for Italian opera, particularly Verdi's, as those who recall his Falstaff will remember. His performance here has dignity, drama and warm lyricism, his orchestra and chorus are always under admirable control, and his singers, though permitted enough latitude to express their own personalities, are unhampered by too strict a discipline.

Although his reading is broad, in the true tradition of grand opera, its success is due to scrupulous attention to details, one example of which typifies his treatment throughout the work — his broadening of the tempo in the march at the end of Scene 1. A fraction slower and it would have been stodgy, faster it would have sounded commonplace.

The soloists are all at the top of their form, led by Tebaldi, assertive but womanly in the title role, and Bergonzi, a manly but never too aggressive Radames. Among the lower men's voices Fernando Corena's (The King) and Arnold van Mill (Ramphis) are always expressive and well in character. Cornel Macneil makes a satisfying Amonasro and Giulietta Simionato's Amneris reveals all that luckless character's feverish jealousy.

The musicians of the Vienna Philharmonic play like angels and the chorus is strikingly accurate in both the big ensembles, such as the Triumph Scene, and the quieter religious chants.

I cannot recall any opera so rich in melodies as Aida, and every one here is beautifully shaped and eloquently delivered.

★ ★ ★

**Verdi — Rigoletto. Complete opera slightly abridged. The Duke of Mantua (Jussi Bjoerling); Rigoletto (Robert Merrill); Gilda (Roberta Peters); Sparafucile (Giorgio Tozzi); Maddalena (Anna Maria Rota); Giovanna (Silvana Celli); Monterone (Vittorio Tatozzi). The Rome Opera House Orchestra and Chorus conducted by Jonel Perlea. RCA mono LB-16239/1/2.**

To get this admirable performance on to two 12in discs made a few minor cuts necessary. These may be regretted by those who know the opera intimately but will, I think, pass unnoticed by others. In any case, some sacrifices had to be made to present the opera in so economical a form and I think the reduced price provides ample compensation for the excisions.

Bjoerling's voice, though displaying trifling signs of wear, remains eminently enjoyable throughout even if true pianissimos are rare. His characterisation is elegant in a mature, rather than a youthful manner without, however, suggesting that he is a day too old to indulge in his many gallantries.

[Since this was written Bjoerling's death from a heart complaint has been announced, a condition which might easily have produced what I thought at the time were "signs" of wear.]

Merrill's vocal acting is consistently effective. He expresses fear, anguish, and tenderness most convincingly without resort to over-emphasis and his singing is always in faultless taste. Roberta Peters is not so successful despite a voice that, young and fresh, should have suited her perfectly for the role of Gilda. A tendency to force the tone results sometimes in quite disturbing unsteadiness on top notes.

Tozzi, as Sparafucile, is a fine, full-ooded villain, splendidly partnered by nna Maria Rota as his enterprising ter, Maddalena, Perlea's orchestra ex-esses all the drama of the score while ver unduly dominating this essentially cal opera. The rising and falling semi-nes in the storm background to the t act are most eloquently delivered.

The chorus is always under benevolent cipline that ensures good tone and ac-racy of pitch, especially in the quiet mbers.

The mono sound is fine though an-her of the problems of economy are ident in awkward turnovers. The fam-s quartet sounds a little too close to e mike in the loud passages, and there a deplorable fall in pitch on the last ord of Act 3.

The set is accompanied by a hand-mely displayed English/Italian libretto nich, however, unaccountably translates e Italian word "spada" as "spade" nen it should be "sword." Much use-l information on Verdi and Rigoletto included. Recommended as outstand-g value.

★ ★ ★

**Ravel—Daphnis and Chloe, Complete Ballet. Performed by the London Symphony Orchestra and the Royal Opera House Chorus, Covent Garden, conducted by Pierre Monteux. Decca stereo SXL-2164. Mono LXT-5536.**

The opening whispers romantically, e chorus enters so softly and sweetly at its presence seems to melt into avel's beautifully drawn landscape, the und increases in volume and richness, d a shattering climax makes the lis-ner marvel at the vitality of the old ntleman who is directing the score th such force and sensitivity.

Daphnis and Chloe is essentially a vir-oso piece. Woodwind solos abound, e brass has to triple-tongue at a dizzy ace, and the strings, too, share gener-sly in the riot of colour and rhythm.

The London Symphony Orchestra sel-om achieves the effortless accuracy it splays in this performance, and just rarely communicates so much excite-ent. But under Monteux' inspired dir-tion the players' response should satis-the most carping of critics.

The mono sound is fine, the stereo ite wonderful, and Decca's engineers ve handled the tricky balance between chestra and wordless chorus with all eir customary skill. Most enthusias-ally recommended.

★ ★ ★

**Grieg — Piano Concerto in A Minor. Liszt—Piano Concerto No. 2 in A Major. Played by Gyorgy Cziffra and the Philharmonia Orchestra conducted by Andre Vandernoot. HMV stereo OASD-301.**

Cziffra's showy style is not to every-e's taste and his exuberance is more n usually out of place in the Grieg ich responds gratefully to more re-ained treatment. But his performance s undeniable brilliance even if it is times a little too dazzling.

The Liszt stands up better to Cziffra's owmanship and the stereo version bal-es the piano and orchestra more sat-actorily than did the mono pressing ued earlier this year. HMV's two-chan-sound is beautifully distributed and piano remains satisfyingly stationary ween the two speakers.

**Beethoven — Piano Concerto No. 3 in C Minor. Played by Glenn Gould and the Columbia Symphony Orchestra conducted by Leonard Bernstein. Coronet mono KLC-2724.**

Gould is a forceful, highly individual young pianist with strong opinions on interpretive problems. Discophiles used to a more orthodox reading of this concerto may find some of Gould's contrasts disturbingly emphatic, and his ultra-slow tempo in the middle movement a trifle mannered.

Moreover Gould formalises much of the gaiety out of the final Rondo.

But his technical skill is never in doubt and his range of tonal variations extraordinarily wide though always used with discretion.

Gould offers many passages of ravishing beauty though whether they provide sufficient compensation for his unconventional interpretation is a matter you will have to decide for yourselves.

Bernstein, another artist with firmly-held unorthodox interpretive convictions, here places his services entirely at the disposal of the soloist. The sound is first rate and the balance exemplary.

*Paul Badura-Skoda*

**Beethoven — Piano Concerto No. 3 in C Minor. Played by Paul Badura-Skoda and the Vienna State Opera Orchestra conducted by Hermann Scherchen. Westminster mono EG-W-18078.**

This is a more traditional reading, though not without a personality of its own. Badura-Skoda concentrates on the more graceful aspects of the work, eschewing Gould's violently contrasted moods and replacing them with a more lyrical concept.

His slow movement never seems like Gould's, about to falter to a stop and the final Rondo skips along like a happy girl, though once or twice its impetus seems to escape momentarily from the player's control. If the sound were better I should recommend it in preference to Gould's.

But Westminster's engineering is not comparable to Coronet's. Scherchen supplies what must have been a helpful accompaniment but the listener hears strings that seem to have been recorded away from the rest of the orchestra, and the solo piano tone is, to say the least, unimpressive.

Solomon's HMV disc is still my favourite performance of this concerto, though why all three versions give such


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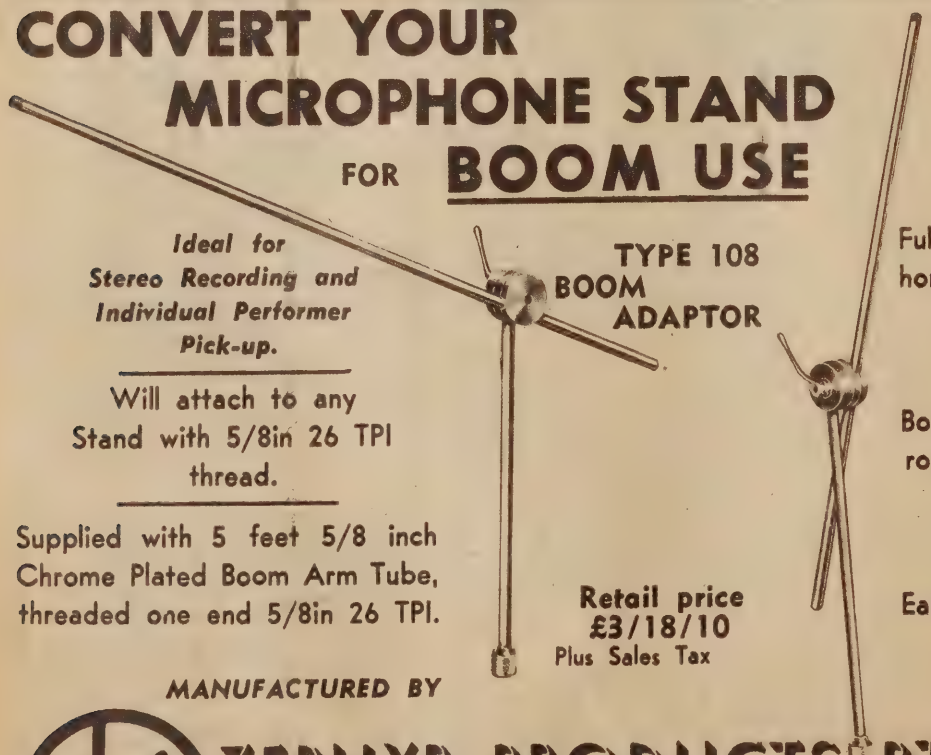

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unnecessary prominence to the woods in the opening bars will always mystify me.

★ ★ ★

**Beethoven — Piano Concerto No. 1 in C Major. Played by Solomon and the Philharmonia Orchestra conducted by Herbert Menges. Piano Sonata No. 27 in E Minor, Op. 90. Played by Solomon. HMV stereo OASD-294.**

This is a stereo version of what is probably the most popular version of the concerto available in Australia—popularity that is well deserved in the opinion of this reviewer. It has received the usual benefits from its transfer—increased width and depth—while the balance of the solo part with the orchestra has been well preserved and remains throughout satisfactorily stable.

The original mono had much to recommend it in the performances of both Solomon and the Philharmonia and in its present form is my unqualified preference to all others.

And as a bonus with the concerto goes Solomon's exquisite account of one of Beethoven's most lyrical sonatas.

★ ★ ★

**Brahms—Double Concerto for Violin, Cello and Orchestra. Played by David Oistrakh, Pierre Fournier, and the Philharmonia Orchestra conducted by Alceo Galliera. Tragic Overture, Op. 81, played by the Philharmonia Orchestra conducted by Alceo Galliera. Columbia stereo SAXO-2264.**

This, too is an entirely successful transfer to stereo of a work that, by its nature, responds gratefully to two-channel repreduction. The chief problem was, of course, to balance TWO solo instruments against a heavily scored background, and this has been brilliantly solved. Not only do the violin and cello remain stationary between the two speakers, they remain equally immovable side by side.

The modern tendency to bring up the woodwind too close in solo passages includes seriously only once—in the first movement, when a flute acquires quite formidable shrillness. Otherwise, I don't imagine the most critical listener being disappointed with the high standard of the engineering.

The two soloists work grandly together, each giving way gracefully to the other whenever necessary, and the orchestral accompaniment is richly sympathetic.

★ ★ ★

**Beethoven—Piano Sonata No. 14 in C Sharp Minor, Op. 27, No. 2 ("Moonlight"); Piano Sonata No. 30 in E Major, Op. 109. Played by Annie Fischer. Columbia mono 33CX—1675.**

Annie Fischer's last-issued disc of Schumann's music was so delightful that its irritating performance of the "Moonlight" is all the more difficult to understand. Little pauses introduced into a fast movement that goes at a lethargic pace give the music the effect of stammering. The atmosphere is quite lifeless and unsparked by any lyrical quality. True, these last appear briefly in the allegretto, but in the finale she trivializes the forceful right hand figures, and has some difficulty with high trills.

But she offers delicious compensation in the F Sharp Minor Sonata and the E Major. In these her playing is never less than elegant, her reading perceptive, and her constantly changing touch a joy. All of which make her playing of the "Moonlight" even more puzzling, unless she felt that she just had to play it differently from anyone else. And even that seems a doubtful explanation.

★ ★ ★

**Mendelssohn—Concerto for Two Pianos and Orchestra in A Flat Major. Played by Orazio, Frugoni and Annarosa Taddei, with the Vienna Symphony Orchestra, conducted by Rudolf Moralt. Concerto for Two Pianos and Orchestra in E Major. Played by Orazio Frugoni and Eduard Mrazek with the Pro Musica Orchestra of Vienna conducted by Hans Swarawsky. Vox mono APL—10540.**

A generation ago it was fashionable to disparage Mendelssohn. Today, younger musicians are not so sure and many of their parents have changed their minds. The Organ Sonatas, Italian Symphony and the Incidental Music to A Midsummer Night's Dream never went quite out of favour, but the other symphonies did, together with much of the music he wrote for piano.

The two concertos recorded on this disc have seldom been heard, at any rate in English-speaking countries, during the past 50 years, and through the sound is far from satisfactory by modern standards it is obvious that the musical world was poorer by their absence from its programs.

The pianos tinkle, with reverberation hanging around their notes, and the orchestral tone lacks distinction. But the pianists play fluently and sensitively, and, what is more important, without any hint of condescension. The sound in the E Major is a trifle better than on the A Flat.

Students should find much to interest them in both works, others had perhaps better wait until someone is enterprising enough to put them out in more up-to-date guise.

★ ★ ★

**Mendelssohn—Symphony No. 4 in A Major, Op. 90 ("Italian"). Tchaikowsky — Capriccio Italien, Op. 45. Played by the Orchestra of the Wiener Musikgesellschaft conducted by Edouard van Remoortel. Vox mono APL—11210.**

As stated above, this was one of the few Mendelssohn works to survive his period of unpopularity. It is a grand little symphony, full of vigour, romance and sunshine. Van Remoortel's performance is satisfyingly bright without being quite out of the top drawer.

He is at his best in the two outside movements which have plenty of rhythmic buoyancy despite woodwind that often sounds as if it is on top of the listener. The strings, too, are a little wiry and the orchestral tone could have been profitably enriched.

The woodwind is again too prominent in the Tchaikowsky piece, and here and there the triangle jangles like harness It is, of course, all deplorably vulgar, but as bright as a button — and occasionally exhilarating.

The sudden increase in tempo in the final fast section is a trifle too vehement.

★ ★ ★

**Antill—Corroboree, Suite from the ballet. Ginastera—Panambi. Suite from the ballet. Played by the London Symphony Orchestra conducted by Sir Eugene Goossens. Top Rank stereo STRC-6031. Mono TRC-1032.**

The sound on this new label, issued here by Festival, is splendid in both its mono and stereo form. The discs are processed here from masters made in America by the Everest Company. The Antill piece responds particularly gratefully to stereo treatment though the hypercritical may find here that the prevalent trend towards over-resonance in almost every recording, of any label, that now comes on to the market, a little too marked for their taste.

But this resonance in no way impairs the extraordinary amount of detail that can be heard in Antill's complex score with its enormous battery of percussion instruments, some of them in general use, and others that, so far as I know, have never been used before. These, though always colourfully audible, are never allowed to dominate the rest of the music.

Corroboree has been a great favourite of Goossens' ever since Antill gave him the score to read many years ago. He and the composer conferred frequently during the initial rehearsals and Goossens' reading might be taken as fully authoritative.

Those familiar with the truly Australian work will recognise at once a masterly performance. Those to whom it is new will find much in it that is both evocative and exciting.

The Ginastera suite will probably be new to most discophiles. It is eminently pleasing music, tuneful enough to be


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**Radio amateurs in the U.S. who have been concentrating their activities on Moon Bounce projects were rewarded with a contact via the moon across the American continent. It was necessary to erect complicated antenna arrays to make this operation possible.**

AMATEUR Moon Bounce Transmissions have made world headlines on a number of occasions. Sam Harris, WIFZJ, has been receiving his own signals on the bounce for some time. His transmitter runs 1 kilowatt to a Klystron at 1296 mc/s and feeds an 18-foot-diameter dish which tracks the moon across the sky. The receiver with parametric amplifier has a noise figure of less than 2db. and a 35 cycle pass band.

Equipment for such amateur ventures is by necessity complicated and it probably is just as well that Sam is a member of Microwave Associates. The daily Press also carried the story of the Victorian division of the WIA's plans for a trans-Pacific contact via the moon.

Sam was rewarded in July when he heard a signal other than his own reflected from the moon. It was the occasion of the U.S. coast to coast working between WIBU and W6HB on 1296 mc/s via the moon.

### CLUB INSTALLATIONS

Both station installations were carried out by club efforts, WIBU by members of the Rhododendron Swamp VHF Society, W6HB by members of Eimac Radio Club of California. Tests on the original contact were carried out over a period of three hours with a telephone link across the continent busy all the while. Signals travelled approximately 250,000 miles to the moon, a similar distance back, and spanned a path of 3,000 miles.

The problems were many and called for high stability and accuracy in several fields. If a contact is to be carried out for a duration longer than a few minutes, an automatic system is required to keep the beam fair and square on the moon over a number of hours. To obtain the required sensitivity in the receiver a band width of 100 cycles or less is required.

Using a three-letter code for "no signal, some signal or good signal" reports and calls were exchanged. The first two-way amateur communication via the moon was history.

### EDITORIAL POSITION

Sam Harris, WIFZJ, incidentally takes over the position as QST VHF editor from October. He has been active in this portion of the spectrum for some 25 years and has contributed to CQ on similar matters. Ed. Tilton, WIDHQ, who had conducted the VHF column for many years, will now concentrate on technical aspects of 50 mc/s and above for the ARRL.

Publicity is being given to the changeover to G.M.T. Universal Time for all amateur radio purposes. The scheme has much merit and 24-hour a day clocks should be appearing in many shacks. Supporters for the scheme say the advantages gained by its adoption are great, especially in times of disaster or national peril. Log keeping would be simplified, contest time records easier and schedule arranging made clearer. Any announcement of a transmission time would mean the same to anyone anywhere.

If you make a schedule with a neighbour at such and such a time you meet him on the dot and the same applies for a schedule with someone on the other side of the world. All amateurs would talk a common time language when working across the different time zones of the world. If you read of a DX station appearing at a particular time you know exactly when he will appear without any mental calculations. (Most DX Editors use this arrangement now.)

## U.S. NAVY WORKING ON DX VHF

Following the world record-breaking 2,540-mile work between W6NLZ California and KH6UK Hawaii on the 144 and 220 mc/s bands, the U.S. Navy has been conducting propagation experiments over this path. The Navy is studying the Trade Wind Duct that was responsible for the KH6-W6 contacts. They used frequencies at 219 and 445 mc/s and amateur co-operation was solicited. Four CW transmitters were used, one of them airborne along the route of the radio circuit.

The main transmitter located in California used 1 kw. on 219 mc/s with a 20 db. antenna. In Hawaii a 200-watt transmitter with a similar antenna was used. The 445 mc/s transmitter ran 100 kw with a 40 db. antenna and is normally used for Moon Bounce work. The aircraft transmitter used 200 watts and a 10 db. antenna. The tests were conducted over a lengthy period but full details of the work are not available.

Later news disclosed that KH6UK and W6NLZ again spanned their now famous path on yet a higher frequency, this time on 432 mc/s. They originally covered the distance on 144 mc/s in 1957 and on 220 mc/s in 1959. The signal of KH6UK was loud and clear in California, but receiver trouble at KH6UK prevented a two-way contact. The two operators had been experimenting on the higher frequency for some months and were rewarded in late July with a breakthrough that lasted for some hours. Signals were again heard on the following night by W6NLZ.

Most of us use a four figure syste for time recording in the log and change to G.M.T. would be simpl There is nothing new in the schem over a couple of decades individual am teurs have been using and supporting th scheme. The fact that the ARRL spo sors the adoption of Universal Time fo amateur purposes should greatly assi its world-wide use.

### HOLIDAY ACTIVITIES

The Six-hour Day weekend sa plenty of field activity in N.S.W. wit conventions and field days in progres The 7 mc/s band on the Sunday afte noon—when the Hunter branch an South-west Zone's scrambles were progress—sounded like the RD conte weekend. The 144 mc/s band was als well populated on the same day whe the N.S.W. VHF and TV section Spring Field Day was in full swin Mobile stations were located on a nun ber of spots in the country. Messag were originated by John Mill VK2ANF and passed to stations in th north and south for relay. Long distanc working was also tried. One of the be contacts made was between Dick No man VK2ZCF at Mt. Tomah in the Blu Mountains and VK2ALU at Murrurund nearly 200 miles.

Weather varied throughout the Sta but good attendances were recorded all events. Winners of the field even at the Hunter Branch Field Day Blackalls were:—144 mc/s Hunt, mor ing, 1st, Stuart Fairburn, VK2ZDF; 2n Harold Whyte, VK2AHA. Stuart wo the afternoon hunt on 144 mc/s al with Ken Mitchellhill, VK2ANU, second place. Bill Hall, VK2XT, won th 7 mc/s Hidden Transmitter Hunt a also recorded a win in the 7 mc scramble.

### W.I.A. NEWS

There was a good response to quests from the Federal Executive the W.I.A. for amateur station log d tails for a weekend in July and one August. This information was requir to provide an assessment of band occ pancy for the W.I.A.'s delegate on th ad hoc committee on frequency alloc tions, Arthur Tinkler, VK3ZV.

W.I.A. officers had a major job co lating the material provided and preser ing it in a form that would be of u to the delegate.

A service to DX enthusiasts will provided by a new arrangement to broa cast over VK2WI short-term ionospher forecasts. These are in addition to th normal predictions appearing in "Am teur Radio" each month. The Ion spheric Prediction Service will provi the information through their "Distu bance Forecaster" and cover variatio from the normal charts. Frank Hin VK2QL, has been working on behalf the W.I.A. in this matter.

Dave Duff, VK2EO, N.S.W. Feder councilor, has been appointed advis on the N.S.W. nightly morse practic covering technical and similar subjec Frank Pearson, VK2ACQ, is still charge of the roster arrangements.

Jim Cuming, VK2PM, won the September Day event of the N.S.W. VHF and TV section. It was a progressive fox hunt, Jim registering three finds, with Bob, VK2OA, Dave XK2AWZ, and Barry, VK2ZAH, one each.

The N.S.W. division's WICEN organisation have moved their practices to 7050 Kcs. for the summer. General practices are held on the first Tuesday of each month at 2000 hours. The third Tuesday is reserved mainly for working and checking with area control officers. Organisation is in the hands of the Blue Mountains section of the W.I.A., with Syd Williams, VK2AVK, and Dave Melbourne, VK2NK, doing most of the control work from section station VK2AUX.

Cross-band working to 144 Mcs. is also carried out and VHF stations in Sydney are co-operating. State President, Bill Lewis, VK2YB, has taken over the duties of "Alerter" for WICEN in case of any emergency. He will be responsible for placing VK2WI on the air if required.

The lecturer at the September meeting of the N.S.W. division was Mr Peter Griffin, of the Department of Civil Aviation, who described in detail the navigational aid for aircraft, the Visual Omni Range.

Both ground and aircraft installations were covered and the lecture was of great interest to members.

## DURAL PREPARATIONS

Working parties are already in operation at the Dural site of VK2WI making preparations for the 1961 State Convention of the N.S.W. Division. It will be held over the Australia Day weekend in January and the organisers promise it will be the biggest and best of this kind yet organised. Full publicity will be provided at a later date.

The Central Coast section of the N.S.W. Division, the Gosford Radio Club, will conduct their well-known Annual Convention on Sunday, November 6. The venue for the gathering is the Gosford Sailing Club, an ideal setting. The usual field events on 7 and 144 Mcs. will be conducted, plus disposals sale and competitions. These days provide an opportunity for amateurs to meet the Brisbane Water gang and up to 300 persons have assembled for these events.

The first gathering in this area goes back to the 1930s and these field days are among the most popular in N.S.W. Mark November 20 down for a trip to Gosford with the family.

## BRAILLE CLUB

On display at the ARRL's South-Western Annual Convention was the Braille Institute's Radio Club, Station WA6GLN. Of special interest were the unusual gadgets that enabled blind persons to operate with the same efficiency as sighted operators. The items displayed included an auditory circuit analyser for detecting circuit defects. The usual meter/needle arrangement, common to this type of equipment, has been replaced by a Braille-marked dial face with plastic pointer.

A similar arrangement was used on a 144 Mc/s frequency meter. The crystals used in the transmitter have the frequency marked on them in Braille.

A transistor auditory gadget was also in operation allowing a blind amateur to tune for maximum RF output.

The Braille Institute has plans to outfit the newly formed club with a full complement of equipment. Already much of it has been donated by individuals, clubs and business groups.

In special classes Blind Amateur Students are given a comprehensive background in amateur operation. Code is learnt from recordings, tapes are available covering regulations and other pertinent information. Available monthly from the Braille Technical Press is a Radio-Electronics Magazine produced in Braille and this covers much of the technical material found in national publications.

## TIMING PULSE

The peculiar buzz heard on WWV lately is a recent addition to the many services broadcast by that station. It is the pulse code which gives the day, hour, minute and second in universal time. The accuracy of the time ticks provided by WWV as transmitted are within a thousandth of a second.

Its purpose is to provide a standardised timing basis for scientific observations at widely separated locations. The pulse code broadcasts at present occupy a one-minute interval immediately following the standard audio frequencies except at the beginning of each hour.

The code is experimental and may be changed as experience dictates. The basic pulse rate is 100 per second and the complete day and time announcement is sent in the space of one second.

Automatic decoding by computer type equipment is contemplated. To amateurs with ordinary receivers it will just remain an unintelligible buzz.

Of interest to certificate hunters will be the new Certificate Hunters Club Certificate, available to amateurs who have won 25 awards from recognised organisations. The 14-inch certificate has additional gold seals and coloured ribbons for amateurs who can provide proof of holding (a) awards from 25 countries, (b) awards from six continents, (c) 50 awards, (d) 100 awards or more. The

# NZART CONVENTION FOR 1961

AMATEURS contemplating a trip to New Zealand next year may like to attend the 1961 convention of the New Zealand Association of Radio Transmitters. The NZART's gathering will be held at Hamilton on the North Island over three days from Saturday, June 3, to Monday, June 5. ZLIAUV, honorary secretary for the convention committee, points out early registration is very desirable owing to the possibility of accommodation shortages at Hamilton at that time.

If you look like making the trip, ZUAUV can be contacted for further information at P.O. Box 636, Hamilton, N.Z.


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# "MULTI-PURPOSE" AMPLIFIER CHASSIS KIT

**Great News for Home Constructors! A new all-purpose Universal version of the famous A. & R. 5 Stereo 7 Amplifier Kit. Similar in outward appearance, this new kit provides for a variety of monaural and stereo circuit arrangements, including pre-amplifier sections to cover the use of high and low level pickups. Here are some suggestions as to the units you can build:**

### PUSH PULL EL 84 STEREO AMPLIFIER

A stereo amplifier and pre-amplifier control unit described in R. TV & H. December, 1959. The single valve pre-amp can be incorporated for a crystal pickup, or for low output pickups the EF 86 circuit in R. TV & H. June, 1959 can be used.

### UNIT AMPLIFIER No. 2 (R. TV & H. AUGUST, 1960)

Another stereo amplifier using p.p. 6 BM 8's in each channel is described in R. TV & H. for August, 1960. This is the "Unit Amplifier No. 2" and is a self-contained circuit with all facilities matching the A. & R. "Universal" Kit front panel The layout of parts can be arranged to suit the "Universal" Kit without difficulty.

### MULLARD 5/10 — or your own STEREO

The kit provides ample accommodation for monaural amplifiers such as the Mullard 5/10 (with or without pre-amplifier) and for possible extension later to a stereo unit. The "Universal" Kit has unlimited possibilities — see it NOW!

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| Type No. | Inductance at Rated Current Henrys | D.C. mA. | Resistance Ω | Maximum Direct Working Volts | Weight lb. | Weight oz. | Mounting Type | DIMENSIONS BASE Mounting | DIMENSIONS BASE Overall | DIMENSIONS Height |
|---|---|---|---|---|---|---|---|---|---|---|
| 3040 | 12 | 100 | 290 | 600 | 1 | 7 | SCL 22 | 3 1/16 | 3 5/16 x 1 3/4 | 2 1/4 |
| 3041 | 12 | 125 | 275 | 600 | 2 | 0 | SCL 22 | 3 1/16 | 3 5/16 x 2 1/4 | 2 1/4 |
| 3042 | 12 | 150 | 205 | 600 | 2 | 6 | VLN 25 | 2 x 1 3/4 | 2 5/8 x 2 1/2 | 3 1/8 |
| 3043 | 12 | 175 | 185 | 600 | 3 | 3 | VLN 25 | 2 x 2 1/4 | 2 5/8 x 3 | 3 1/8 |
| 3044 | 12 | 200 | 165 | 600 | 4 | 4 | VLN 31 | 2 5/16 x 2 1/2 | 3 x 3 1/4 | 3 1/2 |
| 3045 | 10 | 250 | 130 | 1000 | 5 | 2 | VLN 34 | 2 1/2 x 2 1/2 | 3 5/16 x 3 1/2 | 3 7/8 |
| 3046 | 10 | 300 | 90 | 1000 | 6 | 11 | VLN 34 | 2 1/2 x 3 | 3 5/16 x 4 | 3 7/8 |
| 3047 | 5-15 | 250-50 | 70 | 1000 | 5 | 4 | VLN 31 | 2 5/16 x 3 | 3 x 3 3/4 | 3 1/2 |

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first amateur to win such a certificate was Jim Ringland, W8JIN.

Jim received all five gold seals by presenting proof of 131 awards from the six continents. Applicants for this award must include a list of the awards won with their source, date of issue, and serial number. The applicant's QSL card should also be forwarded plus 1 dollar or 12 IRC's.

Applications or requests for information should be directed to the Founder of the Certificate and Secretary, Cliff Evans, K6BX, P.O. Box 385, Bonita, California. It sounds a little like the ultimate in all amateur operating awards.

The 144 Mc/s "States worked" total of individual amateurs in the U.S. is gradually growing and W9KLR leads the roll with a tally of 41 out of the possible 50. Next in line is W9KOK with 40 and close by W4HJQ and W8KAY with 38 worked. The U.S. VHF enthusiasts who spend their time trying to improve these listings watch cold fronts and the like with the enthusiasm of the meteorologist. Most of their contacts over distance are made possible by tropospheric openings.

One of the best known DX operators in Central America joined the ranks of silent keys in September, he was Roberto T12RC. Active for many years especially on 14 Mc/s he will be missed by his many amateur friends throughout the world.

W8OIJ/MM is the call sign of Ralph Peterson operating aboard the s.s. Hope. The vessel is on a tour of the Far East mainly in Indonesian waters as a service from the People to People Foundation. It will provide medical aid and supplies to many communities in that area.

Main amateur radio activity will be on 14345 Kc/s with SSB. The s.s. Hope will spend some six months on its mission.

## UNIQUE QSO

Organisers of conventions are always looking for new ideas that will create interest at their gatherings. A novel approach was provided at a recent German Hamfest by Bob Morgan, DL4SP. He started a QSO with a base station from an aircraft, continued the contact during a parachute drop and finished it on his walk back to base. The 28 Mc/s band was used and a half-watt transceiver provided the mobile portion of the QSO.

With a number of members of one family holding amateur licences in the U.S. the problem of who uses whose equipment and when often arises. Dad may be offended if Junior rates an official observer's ticket when the latter is operating and the senior member's transmitter is in use. The FCC recently regulated on the subject of multiple licences in the one home and the following arrangements are now in force:—

Where more than one amateur station licence and call sign have been issued for the same location it is permissible to operate a single combination of transmitting and receiving equipment under each licence, (an American amateur does not have to specify what his equipment is to be when first commencing operation) provided each station licensee has full control of the station at all times during which his licence and call sign are being used. In such circumstances separate station logs should be maintained and each licensee will be held responsible for all operation under his licence and call sign.

At the corner of Castlereagh & Goulburn Sts.

# OPENING SALE

## FROM SYDNEYS NEW TAPE RECORDING CENTRE—

# SYDNEY TAPE RECORDERS

At S.T.R. it is our aim to provide Sydney's most complete range of Tape Recorders at Sydney's keenest prices. We invite you to come along and prove for yourself how we have achieved this objective. Our opening sale includes the following well-known names:

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**We also have a really tremendous range of used model bargains from £25 cash or on the easiest terms. Models include Stuzzi, Simon, Verdik, Butoba, Revere, Webster, R.C.A.**

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# A BIG STEP FORWARD

## IN PICK-UP ARM DESIGN

# THE M.B.H. EQUIDYNE

### EQUIDYNE — WHAT IT IS

Only with the new M.H.B. pick-ups does the stylus tip touch equally lightly on both walls of the record groove. A unique precision correcting device eliminates side-pressure in the "EQUIDYNE." (Patent applied for.)

All other pick-ups press unequally on the groove walls. Those of the bent-arm or off-set head types always press harder on the groove wall nearest the centre of the record. Straight and pantograph arms start by pressing harder on the inner wall of the groove, and then as the stylus tracks nearer the record centre, this side-pressure is transferred to the outer wall. All these side-pressures exist because the frictional drag of the groove on the sylus is not in line with the arm pivot.

### EQUIDYNE — WHAT IT DOES

**Even Better Fidelity**

The M.B.H. "EQUIDYNE" construction noticeably improves the clarity of both bass and treble reproduction, compared with the previous M.B.H. pick-up arms.

In arms other than the "EQUIDYNE," side-pressure deforms unequally the tiny high-frequency convolutions of the grooves, and also allows the stylus to move easier to one side than the other. This causes distortion, therefore loss of clarity.

**Stylus Wear — 66% Reduction**

Always the most economical pick-up to use, the M.B.H. with the "EQUIDYNE" arm now has even lower running costs. The new arms at least treble stylus life with any M.B.H. head and treble the life of your records.

**Angular Tracking Error Eliminated**

Mathematicians showed long ago that in an arm with correct off-setting of the head, tracking error could be reduced to negligible proportions. However, arms with optimum off-set unfortunately produce excessive side pressure. Now "EQUIDYNE" uses the optimum off-set angle and the compensatory device eliminates side-pressure. This M.B.H. development has made possible a great improvement in the performance of short-length arms.

**"Equidyne" Saves Space in Studio or Home**

Correct tracking up to 17¼" diameter is now obtained from the 14" "EQUIDYNE" arm. This arm saves studio desk space if used in lieu of the 16" arm.

To make possible the use of a smaller cabinet in the home, a new arm of 9" overall length has been introduced. This mounts satisfactorily over a full 12" turntable, unless there is decorative flare or mask around the periphery.

**M.B.H. EQUIDYNE ARMS**

| | | | | |
|---|---|---|---|---|
| Overall lengths to nearest inch . . . . . | 16" | 14" | 12" | 9" |
| Maximum Record diameters to be played . . . . . | 17¼" | 17¼" | 12" | 12" |
| Distance from turntable centre to pivots | | 10½" | 8¾" | 7" |

Music-lovers and broadcasting stations alike throughout Australia have been discovering the superiority of M.B.H. pick-ups. Today more M.B.H. pick-ups are used in Australian studios than any other make, whilst an increasing number of music-lovers testify to their "truly different sound."

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# RESEARCH YIELDS NEW DIELECTRIC

AMERICAN companies are carrying out extensive research into the new and revolutionary form of lighting—electroluminescence—which does not require bulbs, tubes or hanging fixtures.

In electroluminescence, light is produced by pigments which glow when exposed to electrical energy.

Although confined at present to lighting limited areas, such as radio dials car dashboards and nightlights, the new system is expected to expand into decorative lighting within the next five years.

Advantages claimed are that in addition to distributing evenly diffused light electroluminescent lamps will last up to 80 times longer than incandescent lights and up to 750 times longer than fluorescent lights.

One of the problems experienced in research into the new form of lighting was finding a "carrier" or "binder" for the pigments which also would "receive" and "hold" large quantities of electricity (i.e. have a high "dielectric constant").

A synthetic material which possesses these qualities has now been developed by chemists of Cyanamid International a division of the American Cyanamid Company. Called Cyanocel, it is described as a chemically modified cellulose.

Classified as a non-conductor (or dielectric) Cyanocel can "receive" and "hold" up to six times more electricity than any other synthetic material. It also can release this at a high rate.

Its first commercial use will be in an electroluminescent lamp made by General Electric Company.

## DIELECTRIC AND BINDER

Dr J. C. Pullman, of Cyanamid International's Chemicals department, said that Cyanocel acts as a carrier or binder for the pigments in the electroluminescent light. As a carrier, it is the filling in a "sandwich" of two conducting plates, one of which is transparent.

Because of its higher dielectric constant, Cyanocel can be used in thinner sections than other synthetic films. As a result, lamps produced with the new product are lighter, more flexible, and brighter.

Dr Pullman said Cyanocel also offered advantages to designers of electrical and electronic equipment, who were always seeking new ways to reduce the size of components.

Capacitors, which are required in most electrical or electronic circuits, represented a major potential use. A capacitor stores electricity and releases it when needed. Its reduced size was advantageous in designing such varied electrical or electronic equipment as computers, missiles, television and radio sets and hearing aids.

A white, fibrous solid, Cyanocel is made by adding the highly reactive chemical, acryonitrile, to a purified form of cellulose. This cyanoethylated chemically modified cellulose can be made into clear, flexible, transparent films as thin as 0.0001in or as thick as 0.005in. It can also be moulded into shaped articles at high temperatures and pressures.

# ON SHORTWAVE BY ART CUSHEN

## BBC DISCUSSES S/W LISTENING

**A program for short-wave listeners which will give the answers on the complex questions of short-wave transmissions is now a regular feature in broadcasts from London.**

THE new program, called "Short Wave Listeners' Corner," is in the General Overseas Service and sets out o answer listeners' questions on any as-ect of short-wave broadcasting and the 3.B.C.'s short-wave service. Experts rom the Engineering Division, Audience Research, Planning Operations, Publicity, News—anyone who knows the answer—vill be invited to the microphone to give t. Advice on the choice of receivers nd aerials, information on reception, ransmission conditions, and news on orthcoming frequency changes are cheduled to be features of the session. he aim of the whole program is to in-orm, to entertain, to interest, and to elp the short-wave listener. The pro-ram is to be broadcast on Wednesday t 10.15 p.m., and on Thursday at 11.15 m. and Friday at 3.30 a.m.

### ew Mauritius Frequency

ISTENERS in the early mornings are enjoying good signals from the little ard Radio Mauritius in Forrest Side, hich is now using the frequency of 25 Kc. The station has been noted ith light music and announcements in ench to 4.00 a.m., then follows a re-y of the B.B.C. news from London. he announcement, in French, which llows at 4.10 a.m., gives station iden-ication and this is followed by the ational Anthem, "God Save the ueen" when the station leaves the air.

### Signal From Mexico

RECEPTION is noted of a fairly strong signal from Mexico City on 40 Kc., at 8 p.m., when a transmis-n in Spanish is heard. The signal is t of XESM, a station using 1470 Kc. on the broadcast band, and by con-sistent listening it is now identified as a harmonic frequency of the medium wave station.

### Radio Swan Verifies

THE airmail verification for the inter-esting station on Swan Island, re-ception of which was reported last is-sue, has been received.

The station, as well as being received on its short-wave frequency of 6000 Kc., has now been heard in New Zealand by listeners on its medium-wave frequency of 1160 Kc.

The letter verification from the owners, Gibraltar Steamship Company, says the tiny island is 90 miles north-east of Hon-duras and broadcasts are in both English and Spanish. Verification letter is from Spanish. Verification letter is from Horton H. Heath, Commercial Manager, and the address is Box 1247, General Post Office, New York City. Broadcasts are on 1160 Kc., 50Kw., 8.00 to 10.00 p.m. in Spanish, 10.00 to 11.00 a.m. in English and 11.00 a.m. to 12.30 p.m. in Spanish. The short-wave transmis-sions on 6000 Kc. with 7500 watts, 11.00 p.m. to 1.00 a.m. in Spanish, 1.00 to 2.00 p.m. in English and 2.00 to 3.30 p.m. in Spanish.

### HI3U Confirms Reception

THE verification of Radio Caribe, which we reported in the last issue, and which has been heard by many lis-teners in both Australia and New Zea-land, has verified air mail with a long and informative letter on our reception, the first from this area. The station has a network of six broadcast bands and two short-wave transmitters, and the let-ter in Spanish is from the President of the station, Snr. Jose Marti Otero. The two short-wave transmitters both of 10 Kw. are HI2U using 6090 Kc., and HI3U on 9505 Kc., and signals from these sta-tions are received at good strength until sign-off at 5.00 p.m., usually preceded by a news bulletin in Spanish and Ger-man.

### Liberia Extends Schedule

AN extension of its broadcasting schedule to cover listeners in the Middle East and Nigeria was recently announced by the mission radio ELWA, in Monrovia, Liberia. The station has introduced a daily service to the Middle East area using its 50 Kw. transmitter on 15,085 Kc., and this is broadcast from 4.15 to 6.00 a.m. A new service to Nigeria is on the air for three hours each day, and this includes programs in English, and is broadcast 9.00 p.m. to midnight and the frequency is 11,825 Kc.

The seldom reported ELBC in Mon-rovia is being heard on 3255 Kc. from 9.20 to 9.45 a.m. This station has been in service for several years and broad-casts commercial programs.

### New Frequency From Seoul

THE overseas broadcasts of the Korean Broadcasting System are being heard on several new frequencies in the transmissions from Seoul.

NORTH AMERICAN SERVICE No. 1, 3.30 to 4.30 p.m., on HLK6, 11,925 Kc., 50Kw., HLK41, 15125 Kc. 50Kw.

NORTH AMERICAN SERVICE No. 2 12.30 to 1.30 a.m. on HLK6, 11,925 Kc., 50Kw.

HAWAIIAN SERVICE, 5.30 to 6.30 p.m., on HLK41, 15,125 Kc., 50Kw., and 2.00 to 3.00 a.m. on HLK6, 11,925 Kc. 50Kw.

JAPANESE SERVICE, 10.00 to 11.00 p.m. on HLKA2, 970 Kc., 100Kw., HLK52, 6035 Kc., 2Kw., and HLK5, 9640 Kc., 50Kw.

SOUTH-EAST ASIAN SERVICE, midnight to 1.00 a.m., on HLK43, 17,800 Kc., 50Kw.

EUROPEAN SERVICE, 8.00 to 9.00 a.m., on HLK6, 11,925 Kc., 50Kw.

## VIENNA TEST TRANSMISSIONS

SPECIAL test transmissions from the Austrian Radio in Vienna have been eived at good strength on 7245 Kc., ning at 2.55 p.m., and on 6155 Kc. ning at 3.00 p.m. The transmitter wer is listed as 4Kw for these fre-ncies, but the excellent reception uld indicate that perhaps the 20Kw smitter, so far used only in the 11-re band, has been put into service. he station opens and closes its broad-with an identification announcement erman, English and French, and the of the English announcement is as ws:

"This is the short-wave service of the rian Radio, which broadcasts test missions every day in the 31-metre (9770 Kc.) from 11 to 14 hours .T., in the 41-metre band (7245 Kc) 4 to 5 hours, 14 to 19 hours, and 11 hours G.M.T., and in the 49-e band (6115 Kc.) from 5 to 9 hours G.M.T., and 19 to 21 hours G.M.T. We look forward to receiving your reception reports, which should be sent to the following address: Austrian Radio Short-wave Service, P.O. Box 700, Vienna 50, Austria."

The best reception in this area is dur-ing the times of the 7245 and 6155 Kc. test transmissions, the former when clos-ing at 2.55 p.m. and the latter when opening at 3 p.m. Following the open-ing on 6155 Kc., waltz and light music is played by the Vienna station, uninter-rupted for one hour, and then at 4 p.m. the same recorded announcement in the three languages is broadcast. The trans-missions from Vienna have only been received at weak strength for several years, and this vast improvement in sig-nal strength will mean that reception of the broadcasts is enjoyed at better quality, and will be heard by more lis-teners than in the past years.

### News From Noumea

DETAILS on the latest schedule of Radio Noumea in New Caledonia have been sent to us by Robert Ronai, of Castlecrag, N.S.W. The station uses 4000 watts on 6035 Kc. and is received in the evening at good strength in its programs, which are in the French lan-guage. Robert lists the present broad-casting schedule as 4.30 to 5.30 a.m., 9.40 to 11.00 a.m., and 5.00 to 8.30 p.m. The station has been in operation for many years, and in prewar days used the callsign FK8AA and later was known as FJP. Another short-wave sta-tion in Noumea called "Radio Electric" was also broadcasting during the war days of 1940 to 1944, and at the same time American Armed Forces Radio in the island with the call WVUS was also well received in this area, though it oper-ated on the broadcast band.

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## ENCEL ELECTRONICS

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# Radio Aust. New Frequencies

IN accordance with revised frequencies now being used by many countries in the plan of the International Telecommunications Union, Radio Australia in Melbourne is using some new frequencies. To New Caledonia in French 10.30 to 11.30 a.m., now on 15,180Kc. To South-East Asia from 4.00 to 7.45 p.m. in English now on 15,180Kc. To Mid-Pacific in English from 5.44 to 7.45 p.m., now on 7,190Kc. To North America from 10.14 to 11.15 p.m. now on 11,760-Kc. The Asian program is now broadcast from 8.14 to 10.15 a.m., in Indonesian and French on the new frequency of 15,330Kc.

# Flashes from Everywhere

**KATANGA,** the new State of Central Africa in the former Belgian Congo rea, has a new high-powered transmitter on the air from Elisabethville. A .B.C. report says a United States manufacturer installed the transmitter in under two weeks from it being ordered. atest news is that the station is using 993 Kc. and 11,870 Kc., when opening 2.15 p.m. on Sundays. The station lentifies the broadcasts with the new ogan "Radio Katanga."

**ACCRA,** in Ghana, has a transmission in English on the frequency of 540 Kc., and this has been heard from 00 to 4.10 a.m. with a transmission in nglish in the overseas broadcasts from e Ghana Broadcasting Service.

**CANADA** has one transmitter on the r for the Australasian service daily, om 6.25 to 7.05 p.m., on CKLO, 9630 c. It has also combined its North merican and Caribbean service, now oadcast from Montreal and transmit- 1 from 9.00 a.m. to 9.45 a.m. on ,190 and 11,760 Kc. for the service the North-west Territories, from 11.00 5.00 p.m. Radio Canada uses 11,720 ., station CHOL, and 9585 Kc. with call CKLP.

**ZANZIBAR** is being heard by a uth African listener on the frequency 6005 Kc. to sign off at 2.30 a.m., and en closing the station identifies in ee languages, including English. The nsmission is heard only week days, ich in this area would mean it is sil- on Monday morning, and the full nsmission time is 8.25 to 9.30 p.m. from 9.30 to 2.30 a.m.

**MELBOURNE,** in common with ny other countries, will be altering transmission times in the next few ks to correspond with the use of the nal clock time in the northern hemi- re. Most notable change is the smission to Europe from Radio Aus- a, which will now be broadcast 5.44 to 7.00 p.m., using 11,710 The popular DX session will then eard at 6.45 p.m. every Sunday.

**MMAN** in Jordan is at present ng its new 100 Kw. transmitter, and ng the broadcasts asks for reception rts in announcements made in English, Hebrew and Arabic. The latest frequency to be used is 9530Kc, and it has been heard here to sign off at 9.15 a.m. by North American listeners.

**DAMASCUS** has recently retimed its transmission to Latin America from Syria, and the broadcasts, which are still carried on 15165Kc, have now been observed from 9.00 to 11.00 a.m. The service to Europe on the same frequency has news in English at 6.15 a.m.

**TUNIS,** which, since its first broadcast only a year ago, has been heard widely, has now been noted on 11975 Kc, with a service in Arabic to sign off at 7.00 a.m. The full transmission is from 5.00 to 5.30 a.m. and from 5.30 to 7.00 a.m.

**VENEZUELAN** station Radio Tropical at Caracas in Venezuela is now being heard on its new frequency of 4900 Kc. Latest reports are that the station opens at 8.30 p.m., and sign-off is at 4 p.m. the next day.

**YEMEN** station Radio Sannah operates on 5986 Kc. This station, which has its entire programs in Arabic, has been noted in South Africa from 2.45 to 5.00 a.m.

**TANANARIVE** has altered its frequency from 3315 to 3290 Kc., and has been heard on this frequency by New Zealander Dick Pollard of Nelson. The station has broadcasts in French and Balgash, and it is also carried on the additional frequency of 5010 Kc.

**IVORY COAST** is reported to be received with better signals due to the reduction of interference, and the Abadajan signals seem to have benefited from the new frequency sharing. The transmissions of the Ivory Coast station, heard from 6.45 a.m. with French news and music, closes down at 9.30 a.m. The station is being received on 7215 Kc.

**GABON** with broadcasts from Radio Libreville has been heard from 3.30 a.m. to sign off at 7.00 a.m. This station in the former French Equatorial Africa is using 4774 Kc., and the station has French and local languages.

**IRAN'S** new 41 metre band channel of 7280 Kc. has been heard in Persian from 2.30 to 4.30 a.m., and this signal is being received in Europe.

**SARAWAK** with the broadcasts in Malay and English have been using a new frequency for this service, on 6060 Kc. The station has also been heard on 4950 from 6.30 to 12.30 a.m. with the same program. Broadcasts from Taiwan have put into use a new frequency of 9720 Kc. for its popular request show at 10.30 to 11.30 p.m. The station has also been using the frequencies of 7130, 15225, 15345 and 17785 Kc.

**ULAM BATOR** in Mongolia has dropped its frequency recently, now being heard on 9655 Kc. from 6.00 to 1.00 a.m. Reception is best before 7.00 p.m. and the program in Mongolian suffers considerable interference.

**CAIRO** also has made a move in frequency and now uses 11940 Kc. for its transmission to Europe with the English program being broadcast from 7.30 to 8.30 a.m.

(Continued on page 142)

# ELECTRONICS EDUCATE THE DEAF

**"One of the great problems of education is how to teach deaf children not only to speak, but to give them an education as good as a normal child." This was the theme of a recent broadcast by Arthur Garratt in a BBC General Overseas Service Program, "Science and Industry."**

"Electronics is helping a great deal," Garratt said, "and for some time all British schools for deaf children have used electronic links between teacher and class. To avoid connecting wires, induction loops can be used. A wire is run round the classroom and this carries amplified speech currents from a microphone carried by the teacher. Each child wears a modified hearing-aid with a small coil to pick up these currents magnetically; this coil is really the secondary of a giant transformer, the primary being the loop.

"The trouble has been that the magnetic effects couldn't be localised and so speech 'spilt over' into the next classroom. The Westrex Company in London has now solved this spill-over problem by using a specially-shaped loop which is hung from the ceiling. These loops are called 'slot-inductors' and the system is now in operation in a number of schools for the deaf."

Garratt recorded his broadcast at the Mary Hare Grammar School, about 50 miles from London, a very modern school especially for deaf boys and girls, and he proceeded to demonstrate for listeners overseas how the children, all connected up with the slot-inductor equipment, could take part in lessons as if they had no hearing deficiences whatsoever.

He went on to show how the voices of teacher and pupils could be heard perfectly in all parts of the room, whether they were moving or stationary, and how the slot inductor system was so arranged that the magnetic field fell off as the speaker approached the wall dividing the classroom from the next one, so that there could be no interference between one classroom and another. He found that the wire trailing from the breast microphone worn by the teacher in no way impeded his movements when walking about the classroom.

"The loop system can also be used out of doors," Garratt added, "and Westrex have developed a small transistorised set which the teacher carries. This enables him to talk to children over a range of about 30 feet, so deaf children can be taken out for walks just like normal children."

# ANSWERS TO CORRESPONDENTS

**J.W. (Oaklands, N.S.W.)** suggests that we explain about vibrato units for guitar amplifiers in the "Answer Tom" section of the magazine, and also asks if we have described a guitar amplifier in the past.

A.: We have described guitar amplifiers, J.W., the issues involved being those for August, 1948, and December, 1954. Regarding the explanation of vibrato units in "Answer Tom," we will be unable to do this for some time, as we are starting a series of articles in that section explaining test instruments. We may be able to deal with this matter later on, but perhaps we can briefly mention the principle here.

Basically, the vibrato unit modulates the amplitude (or sometimes the frequency) of whatever signal is passed through the amplifier at a low frequency, usually from 6-30 cycles per second. This can be done by using a low frequency oscillator and using it to modulate the HT current of the amplifier. Another way is to use a small motor to rotate a magnet slowly near a coil. The coil is wired in series with the HT line to one of the pre-amp valves in the amplifier, and the low frequency voltage induced by the rotating magnet thus modulates the signal passing through the amplifier.

**D.E. (Lithgow, N.S.W.)** asks if we can supply information regarding TV aerial boosters for use in fringe areas.

A.: We are afraid we cannot help in this regard, D.E., but we suggest you contact one of the local TV antenna manufacturers. We understand that at least one of these companies, the Channel-Master Company, has been investigating TV booster amplifiers.

**K.J.H. (Kingsford, N.S.W.)** asks if we can supply him with a circuit for a transistor RF section to convert a transistor record player into a radiogram. He adds that he has found the RF section of the "Transporta Seven" set to be lacking in sensitivity when used with his amplifier.

A.: Well, K.J.H., the only thing we can suggest is to use the RF end of the "Countryman's Eight," featured in the July, 1960, issue. This design uses an RF stage and has better signal-noise ratio. However, we suspect that your present tuner is not operating correctly because the "Transporta Seven" circuit has plenty of gain.

**S.T. (Croydon, N.S.W.)** sends us the circuit of a one-transistor amplifier which he constructed, and asks us to comment, adding that he has obtained quite strong loudspeaker volume with a crystal set.

A.: The circuit is satisfactory, S.T., but will produce a certain amount of distortion, due to the fact that the base of the transistor is not biased. And, in the absence of signal, is near cut-off. Thus the circuit only amplifies properly on the negatitve half-cycles of the input. As you say, this distortion is not apparent using the crystal set, but becomes apparent when a microphone is used. Providing bias for the base of the transistor will reduce the distortion considerably, and in this regard we suggest you refer to the circuit in the April, 1957, issue for a "Transistor Crystal Set."

**V.B.M. (North Balwyn, Vic.)** suggests that much of the discussion about "hole in the middle," is prompted by programs that are not true stereo in the first instance, or by the listener's failure to secure true balance. He feels that the introduction of an artificial centre channel merely depreciates the separation which the system is supposed to give.

A.: Thanks, for your ideas will be of interest to other readers. As you probably appreciate the whole subject is open to much speculation and debate.

**"Faraday" (Oatley, N.S.W.)** sends in a contribution for "A Reader Built It" and also asks various questions.

A.: Thanks for your contribution. With a well set-up stereo system "hole in the middle" should not be a serious problem. Individual enthusiasts who feel that it is sometimes use a centre speaker which is fed with a signal representing an addition of the two stereo signals. This addition can be effected by taking a "split" off the two channels and amplifying it through a third amplifier. and speaker. Alternatively it can be derived from the respective voice coil windings.

Thank you for your various suggestions, all of which have been noted.

**F.L.B. (Semaphore, S.A.)** asks if we publish a booklet or magazine giving full particulars of International Short Wave broadcasting stations.

No, F.L.B., we ourselves do not publish such a booklet. However, there a many such booklets around, such as t "World Radio Handbook" recently viewed in the magazine. We suggest th you contact your local bookseller in th regard, as he may have this or simil books already in stock.

**B.K. (Bendigo, Vic.)** compliments on the "Here's Your Answer, Tom" se tion of the magazine. He asks if would indicate how (or if) crystal a magnetic pickups can be used as micr phones for speech and for attaching musical instruments.

A.: Thanks for the kind words, B.K it's nice to know that the section can of assistance. In general, it is not pra tical to adapt pickups as speech micr phones, but they can be used quite su cessfully as pickups for musical instr ments. What is generally done is fit the unit so that the needle clamp stylus bar is rigidly clamped to t souding board of the instrument. T body of the cartridge is then resilient mounted to the instrument by cork felt pads. The pickup is conected in t normal way to an amplifier or rad pickup terminals.

**D.B. (Merredin, W.A.)** asks if OC or OC71 transistors are suitable for R amplification. He also asks if we inte describing an inverter to operate fro 32 volts DC, and if we could discu electrostatic loudspeakers and compa them with cone type loudspeakers.

## RADIO, TELEVISION AND HOBBIES QUERY SERVICE

TO assist our readers, "Radio, Television and Hobbies" conducts a technical query service. Conditions governing this service are set out below:—

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications of merchandise must be obtained from our advertisers.

(8) Technical queries are not answered by telephone.

Well, D.B., that's rather a tall order, but we will start at the front and work through them. Firstly, the OC71 and OC70 are audio transistors, with an alpha (common base current amplification) cut-off frequency of from 10 to 15 Kc/s. They are thus completely unsuitable for RF amplification.

We have no immediate plans for the description of a 32-volt inverter, but we will keep the idea in mind as a possible project. As for the discussion of electrostatic loudspeakers, we feel that this is worthy of more space than we could devote to it in this column, so we will file the idea away for possible future use in the "Here's Your Answer, Tom" section of the magazine.

**D.B.G. (Wattle Park, S.A.)** asks if we have ever published details of a "walkie-talkie" in the magazine, and whether the issue involved is still available.

A.: We did publish a circuit of this type, D.B.G., called the "Handie Talkie for Amateurs." It was in the October, 1950, issue, but this issue is no longer available. However, the circuit and photographs are still available through the Query Service advertised on this page.

**J.F.I. (Fitzroy, Vic.)** suggests that we consider publishing details of a binary counting circuit using germanium diodes and a light intensity meter using a germanium photodiode.

A.: Interesting though these projects may be, J.F.I., we feel that they would not appeal to the majority of readers, and thus are a little unsuitable for publication. However, if sufficient interest is indicated, we would consider the projects.

**R.J.D. (Midland Jn., W.A.)** sends us a cutting from an American digest referring to an alleged reception of an American television test pattern in England three years after the station concerned closed down. He asks us to comment on this cutting, and whether we would consider reviving the "Junior Experimenter" series of articles.

A.: While we would not rule out the possibility of the "strange journey in outer space by radio and television waves" suggested in the article, R.J.D., we feel that a more likely explanation is one of coincidence. Many American television programs are rebroadcast in overseas countries, and it is not unusual for the films used to contain the original commercials and test pattern.

Thus a freak atmospheric condition could result in reception of the "program from the past" described.

We have not to date considered reviving the "Junior Experimenter" series, but if we receive indication that it would be well received by readers, we will certainly give serious consideration to the idea.

**A.D. (Epping, N.S.W.)** asks us a number of questions about colour television, and suggests that we answer them in the "Answer Tom" section of the magazine.

A.: Colour television has been operating in America (using the N.T.S.C. compatible system developed by R.C.A.) for some time now, A.D., but there are a number of disadvantages found in practice which are partly responsible for its non-appearance on a large scale in the country.

One is that both transmitting and receiving apparatus are much more complicated. This means both the cost of the apparatus is increased, and the cost and frequency of maintenance calls is increased also. Men to service colour TV must be trained to a much greater extent than in the existing monochrome field. Finally, the system is not perfected and still possesses a number of undesirable features which will have to be removed before it becomes universally acceptable.

We will deal with the technical aspect of colour TV in the magazine at a later date, A.D., but for the present that's about all we can say.

**B.C. (Toboroa, N.Z.)** sends us some tips concerning television, and radio servicing, and compliments us on the magazine, adding that he particularly enjoys the "Serviceman Who Tells" and "Here's Your Answer, Tom" sections.

A.: Many thanks for the tips, B.C., which we will try to include in the "Reader Built It" section of the magazine in the near future. We have not to date considered the possibility of a published list of serviceman's tools, but we will bear this in mind. Finally, many thanks for your compliments on the magazine.

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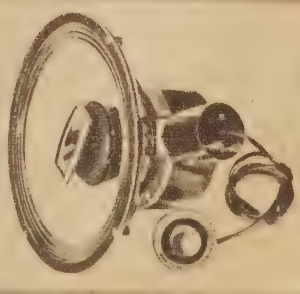

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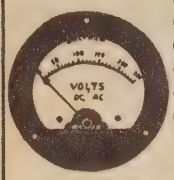


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# COLLOIDS ARE IMPORTANT

(Continued from Page 15)

POLAR substance. This is important to remember.

Oils on the other hand possess no strong electrical characteristics and have a tension considerably lower than that of water.

The reason, therefore, that oil and water will not mix is because the electrical properties of water repel the intrusion of a non-electrical substance such as oil.

The point at which a drop of oil is in direct contact with water is called the interface and, because it is at that point that the water exerts its greatest repellent force, the term interfacial tension is used. The interfacial tension in this case is high.

The problem then resolves itself into reducing or destroying this interfacial tension so that the oil can penetrate the water and form an emulsion consisting of suspended colloidal particles.

If then we could interpose some substance which would alter the electrical state of repulsion we might achieve the required result.

## FATTY ACIDS

This is just what happens when we introduce into the mixture one of the substances known as fatty acids; these include stearic acid, oleic acid and palmitic acid. Certain alcohols also exhibit the wanted characteristics.

Some years ago two American workers Dr Irving Langmuir and William D. Harkins presented a theory of what happens when these fatty acids or alcohols are mixed with an oil and water solution. This theory has been generally accepted and can be simply stated in the following words.

Mixing of a fatty acid or an alcohol with water and oil with agitation results in the oil becoming coated with a layer of fatty acid or alcohol only one molecule thick.

Now the molecule of the fatty acid or alcohol, hereinafter referred to as the emulsifier, is polar, like that of the water. It has a negative charge at one end. As unlike poles attract, the negative end of the emulsifier molecule clings round by the attraction of the positive charge of the water molecule, resulting in the head of the emulsifier molecule being in the water and the tail sticking in the oil.

Thus the head of the molecule can be said to be soluble in water and the tail soluble in oil. There is thus formed a situation where the interfacial tension between the oil and water is broken down and the result is a colloidal suspension of, in this case, oil in water.

Having got our emulsion, the problem remains to stabilise it. This can be done in several ways, the most convenient being the introduction of a protein such as gelatin, egg white, gum arabic, or even tragacanth.

The action of soap is dependent on the emulsifying properties of the fatty acids of which it is composed. Having a strong affinity for water, the fatty acids form an emulsion with dirt and grease particles.

Modern detergents are groups of chemical which are more effective than soap in breaking down interfacial tension and therefore are said to have more "wetting power" than the soap molecule, thus allowing speedier emulsification.

The human body depends on colloidal particles for its existence. To enumerate all these would be beyond the scope of this article. Blood, however, is a prime example of colloidal suspensions. Suspended in it are the four important proteins of albumin, gamma-globulin which contains disease-resisting antibodies, prothrombin and fibrinogen, which have to do with the coagulation of the blood.

In addition to these, there are sugars and mineral compounds suspended in the plasma of the blood.

Because of the important part which fats and proteins play in the nutrition of the human body, it is natural that these would be found in colloidal suspension in many of the foods which we consume.

Milk is a natural emulsion of butter fat in water. Although it has not been positively established, it is believed that each globule of butter fat is encased with a protective protein which stabilises the emulsion. The larger particles of butter fat, not being of colloidal size, rise to the surface in the form of cream.

It is possible to make butter from this, because the churning process breaks the protective protein coating and allows the butter fat to stick together.

A newly developed process prevents the large butter fat particles from rising to the surface of milk and is used to make a uniform emulsion of milk and butter fat which is more digestible.

The process is called homogenisitation and consists of forcing the whole milk between plates held very close together. This breaks up the larger fat globules to colloidal size, preventing them from rising to the surface.

Space does not permit of a further discussion of the wide applications of colloidal chemistry. Enough, however, has been said to perhaps stimulate further study of this most important branch of science.


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# ON SHORTWAVE

(Continued from page 137)

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**MOMBASA** in Kenya on 4965 K has been noted in South Africa to 6.3 a.m. When closing in English the stati gives identification and says they resun broadcasts at 1.30 p.m. the followi day.

**Notes from readers should be sen to Arthur Cushen, 212 Earn Street Invercargill, N.Z. All times are Aus tralian Eastern Time.**

**ADDIS ABABA,** which has be moving in the 49 metre band, has s tled on 6185 Kc., and broadcasts English take the air from 4.15 to 4. a.m., then follows a session in Somali sign off at 4.00 a.m.

**AFGHANISTAN** since it moved the 15385 Kc. channel is giving go signals in this area with the English p gram from 5.00 to 5.30 a.m. This tra mission was formerly on 9710 Kc., a this is replaced by the new frequen The Radio Kabul station opens at 4 a.m., at 4.30 a.m. has French, and fr 5.00 a.m. the transmission is in Engl


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(Continued from Page 129)

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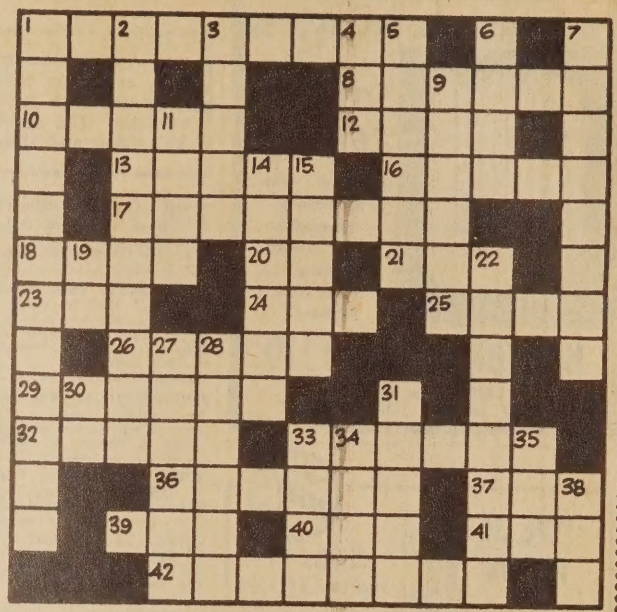

**ACROSS**

1. The number of cycles per second in any form of wave motion.
8. High component.
10. Happening.
12. Chinese money.
13. They have the ability to produce voltage in their own windings.
16. European river.
17. Term for a signal lamp.
18. Scandinavian name.
20. Alternative.
21. Edible root.
23. Self-interest.
24. Veer to one side.
25. Fish.
26. Has he got long legs?
29. Signatures in music.
32. Tools.
33. Foolish.
36. It does not matter which.
37. Fastener.
39. Unit of work.
40. One of a pair.
41. Confederate general.
42. The metal shell of an electronic tube.

**DOWN**

1. An electron that does not move in a regular orbit.
2. They can be either anodes or cathodes.
3. Up till the time that.
4. It gave its whisker to science.
5. Once every 365 days.
6. Large container.
7. One of the three beams in a colour television picture tube.
9. Raise the temperature again.
11. Counted at meetings.
14. Where A.1 is A.1.
15. Capacities in a circuit other than in its condensers.
19. The symbol for silver.
22. Term for a gang condenser.
27. The unit of flow of electric current.
28. Plan.
30. Exclamation.
31. Animal.
33. Another one of another pair.
34. Bird.
35. Cube.
38. Snare.

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| T | | C | R | I | S | I | S | | | | A | M |
| S | C | I | O | N | | C | O | | T | I | K | I |
| T | | T | A | G | | A | L | L | | B | E | N |
| O | | Y | D | S | | N | A | Y | | E | R | A |
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| E | F | F | E | C | T | | I | | L | I | E | S |
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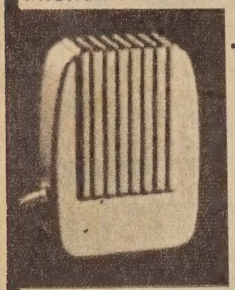

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